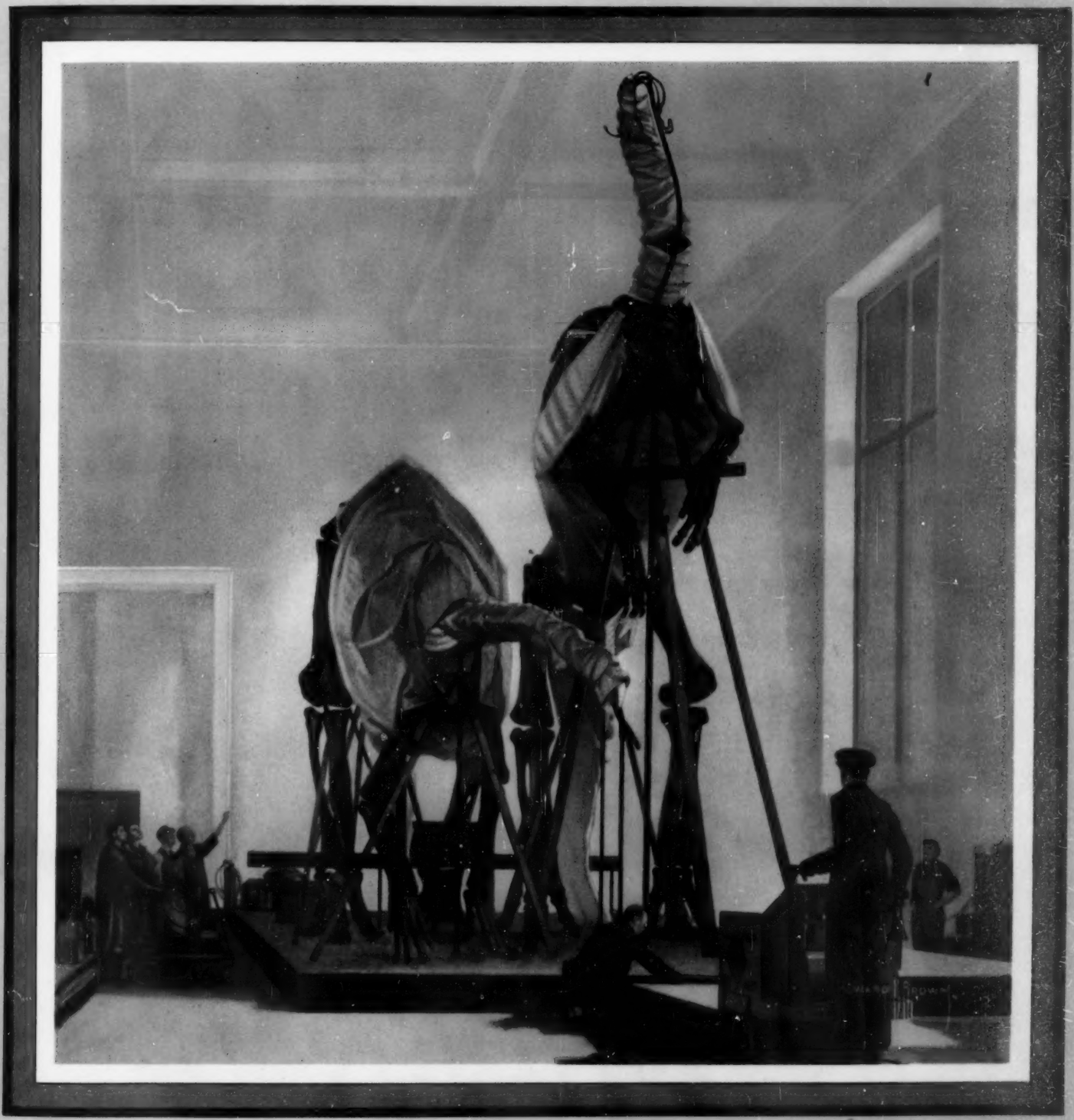
SCIENTIFIC AMERICAN

GUESSWORK—OR SCIENCE?
By Francis A. Tondorf, S.J.

IS OUR OIL INEXHAUSTIBLE?

A NEW ALIBI FOR THE GOLFER



MODERN METHOD OF MOVING MONSTERS

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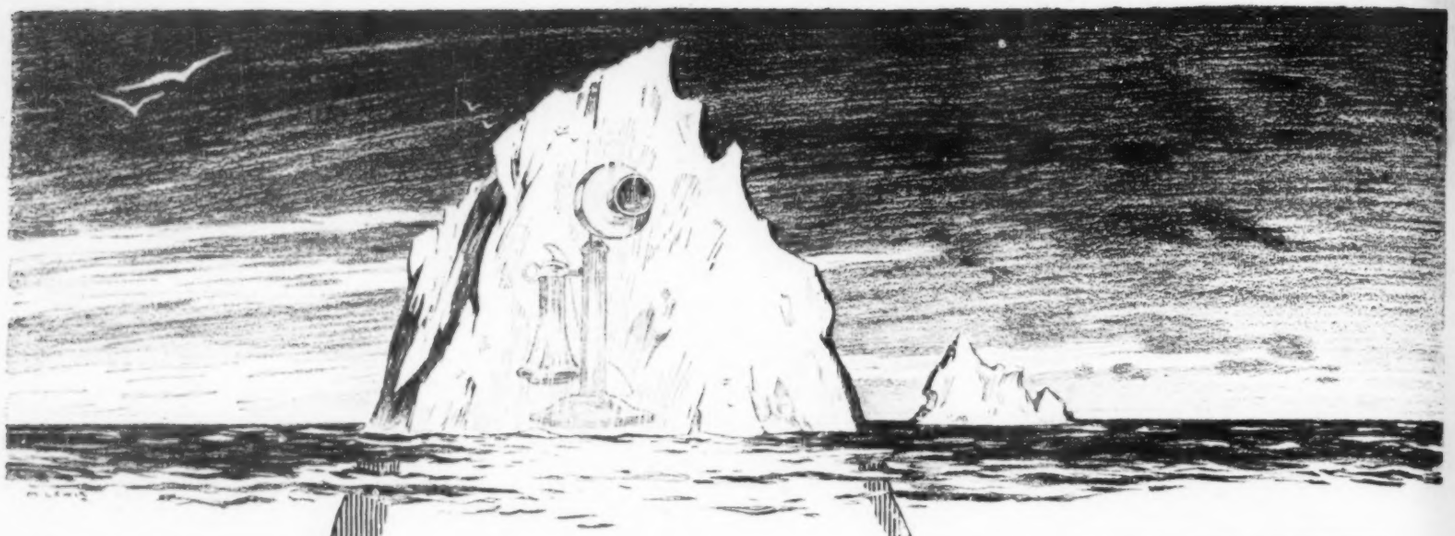


Telephones *and* Icebergs

don't overlook the part you cannot see

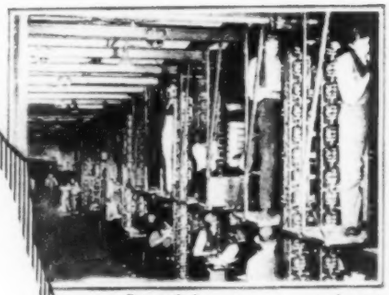
With the telephone system as with an iceberg, by far the greater part is unseen. The instrument on your wall or desk calls into action vast equipment, all of which had to be produced to a standard of accuracy rarely found in industry.

Whether it is the making of your Bell telephone, or the wires and cables connecting it to the central office, or the maze there of distributing frames, relay racks and that marvel of intricacy, the switchboard—here is a work which calls for the skill gained through long experience.

From the buying and testing of the raw materials, through every step of manufacture and inspection to the finished apparatus; further, to its delivery on regular or emergency order—and even to switchboard installation—all this is Western Electric's responsibility.

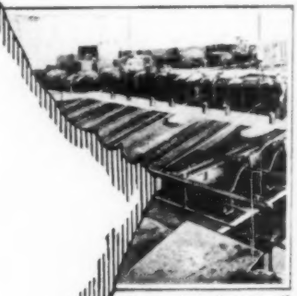
And through this responsibility has come during forty-four years an ever-increasing opportunity of service to the American public.

Millions of poles are in the vast system "back of the telephone."

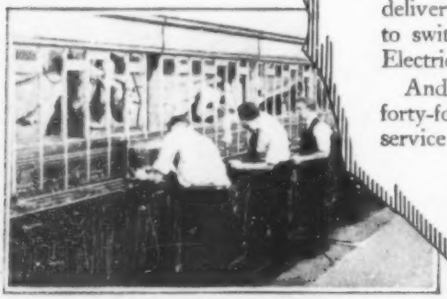


Part of the great unseen equipment that goes into a telephone exchange.

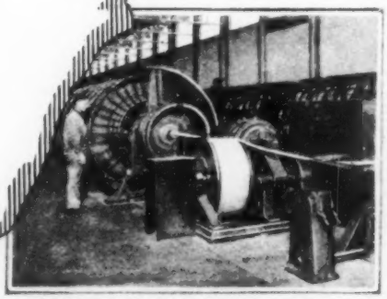
Many busy hands braiding threads of conversation—the telephone cord.



Just wire—but see all the equipment needed to make it.



Assembling a giant switchboard, made up of thousands of parts.



Huge machines like these are needed to produce telephone cable.

Back of your telephone

Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM

Shaped in steel—here is beauty you can use as well as admire. Spilled perfume and inks do not mar the enduring beauty of Sheet Steel furniture.

Still he wouldn't believe it was Sheet Steel

It happened in a Pullman.

Two men were talking about the safety of all-steel cars.

"And notice the beauty of this interior," continued one of them.

"Oh, this interior isn't Sheet Steel," returned the other. "It's just the exterior and frame that's steel."

Even the conductor and the brakeman couldn't convince this man that Sheet Steel was under the beauty of the wall coverings, berths and furnishings.

Yet Sheet Steel is used for products that require far finer workmanship than is demanded by Pullman Car interiors. You will find Sheet Steel beautifully shaped—welded into the most graceful furniture for home and office. Its great strength allows the designer to work unhampered. Finishes can be baked on to endure through a lifetime of use. These finishes resist spilled perfumes, ink, acids — even a lighted cigarette can burn itself out without a trace.

There are many products that can use Sheet Steel to advantage—to add enduring beauty, to reduce weight, to increase economy in first cost or in use. Manufacturers and designers should study the possibilities of Sheet Steel for use in fabricating their products. An interesting booklet, THE SERVICE OF SHEET STEEL TO THE PUBLIC, *contains many suggestions. A copy mailed on request by the* SHEET STEEL TRADE EXTENSION COMMITTEE, OLIVER BLDG., PITTSBURGH, PA.

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Shaped in Steel

SHEET STEEL FOR SERVICE

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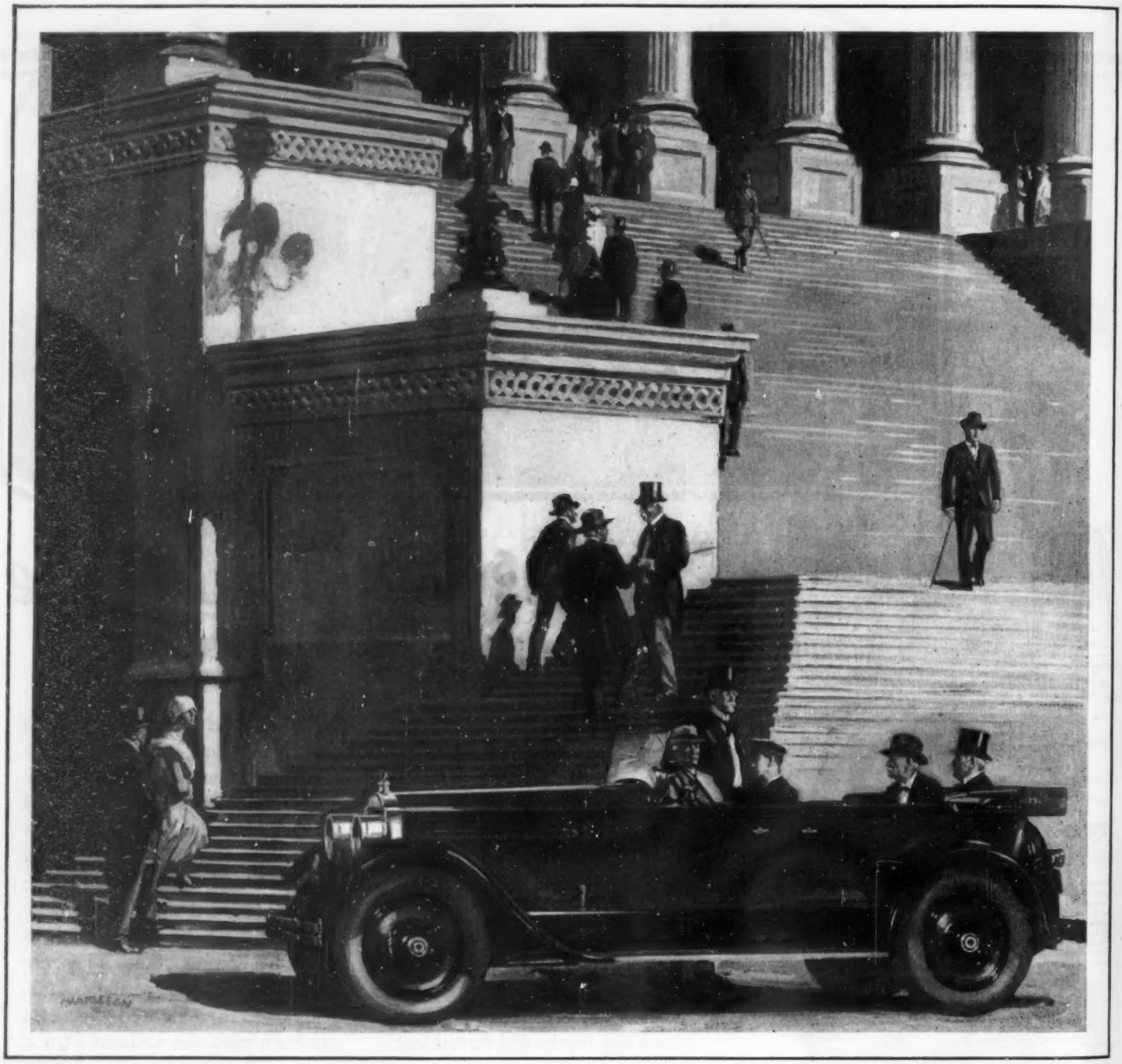


Serving America's Aristocracy

America has its aristocracy of intelligence and culture, of achievement and wealth, of taste and talent. Every community has its leaders of thought and action. And historic Washington—drawing its leaders from every section of the Union—is representative of the aristocracy of them all.

There in the world's greatest capital it is natural to find Packard cars honored by marked preferment—now as for a generation past. That five of the distinguished jurists of the United States Supreme Court own Packard cars is but an indication of this preference among those whose taste and judgment is unquestioned.

The list of cabinet members, senators, ambassadors and congressional leaders who consistently favor Packard with their patronage reads like the roster of an American peerage. Packard could cite no stronger credentials.

PACKARD

ASK THE MAN WHO OWNS ONE

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, AUGUST, 1926 | *Edited by* ORSON D. MUNN | EIGHTY-SECOND YEAR

CORRECT

SOME interesting sidelights were developed by our recent question as to the highest number that can be expressed by three digits. Many answers to this problem have been received, quite a number of them from well-known mathematicians. Even these are not in entire agreement. The consensus, however, is that the correct answer is $9^{(9^9)}$ the equivalent of 9 raised to the 387,420,489th power, a number which would require over 27 years to write.

VELOCITY

HERE is another problem of a different kind. There is no "catch" in it. When the Chicago-Cincinnati-Pittsburgh Limited crashed into the stationary Pittsburgh-Washington Express, in Pennsylvania on June 17, killing some fifteen passengers, the two heavy locomotives of the moving train, backed by nine Pullmans, telescoped three steel sleeping cars their full length. These looked as if they had been ripped open by T. N. T., or by a giant can opener.

How does the energy delivered by this heavy train moving at 50 miles per hour compare with that of the shell of a sixteen-inch U. S. Naval gun, striking at a velocity of 2,800 feet per second, assuming the train to weigh 1,200 tons and the projectile 2,100 pounds?

Before calculating, record your offhand guess or estimate—it will probably surprise you afterwards.

SOVIETS

WHAT a bizarre picture of conditions in the world of science in Soviet Russia one gets after noting sundry evidences that reach this country from the confines of that hazy pseudo-civilization. The Soviet government, having suppressed all public display of religion, is attempting to exalt science in its place. True, a little serious scientific work is now being done in Russia. In the meantime science lives in rags. "It was indeed a little embarrassing," writes a noted British scientist, after a visit to Leningrad, "to meet men of refinement and learning whose trousers were eked out with large and unrelated fragments."

The Soviets will find that elevating science is easier than extirpating religion. Science is based on the rational faculties, while religion is an emotion deeply planted in the human heart where it took root a million-odd years ago, probably as magic. There is room for both religion and science. It is theology, not religion, which quarrels with science. History shows that theology always loses, always retreats somewhat, "digs in" again and absorbs more punishment. It never learns.

In This Issue

How Do They Know?

At the very same hour of an earthquake, scientists the world over know when it happened, how far off and where. The interesting part of it is, they are practically always right. How do they do it? On page 90, one of them explains how simple it is.

Controversy

Lots of people find it difficult to convince themselves that the remarkably advanced Mayan civilization could have been originated by the American Indians. They must have borrowed it from the Old World. "Dead wrong," say most authorities. On page 84, one of these authorities drives a spike in the Old World origin theory.

Science and the Golf Ball

A noted scientist has been putting golf balls through some revealing scientific tests. He finds they could be improved a lot—if science were called in to help. For example, they could be made to drive farther. Will every player soon have golf balls built to his own specifications? See page 106.

Down in Davy Jones' Locker

How would you like to sit in a comfortable, cozy little room at the bottom of a sunlit tropical sea, watching the fishes glide by and studying an ever-varying panorama of coralline life? Read Dr. Miner's vivid narrative on page 87 and you will believe you have actually been transported to the bottom of the sea.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 159.

For Next Month

The Pole—"How Did Byrd Know He Reached It?"

The sun compass, the drift indicator and the bubble sextant guided him accurately. Very good, but how do these instruments function? Next month they will be explained, and simply, too.

The Oldest House in the World

A noted British archaeologist has discovered the wooden remains of a human habitation buried under strata of earth nearly a million years old. What this find signifies will be told in our September issue.

Next, the All-Metal Dirigible Airship

Government and other experts have been hard at work designing an all-metal airship. Now it is about to be built for the Navy. Its completion may herald a wonderful advance. Read about it.

Other articles on, The Norfolk Islanders; The Level of the Great Lakes; The United States Lighthouse Service; Plants That Grow in Airtight Containers; A New Express Cruiser; The Gennadeion; The Sennar Dam; Conservation; Radio; Astronomy.

MORE THAN 200 PICTURES

¶ **There is one best way to keep in touch with the leaders in the world's progress—by consistently reading the Scientific American.**

$4.00 brings the Scientific American to you for one whole year.

DINOSAURS

ONLY the other day in passing through the reptile hall of the American Museum of Natural History, we saw a headless skeleton of a dinosaur being moved to one of the great galleries. It was a weird sight to see this relic of ancient life being moved along gingerly by a modern electric tractor. The sight was so fantastic that we got our artist busy. On the cover of this issue you see the result.

NONSENSE?

THE United States Chamber of Commerce says that American manufacturers are spending about $35,000,000 a year on research. This seems like quite a lot of money, especially since most of it sinks out of sight, at least for a while. But the Chamber also estimates that in the long run this same investment saves the manufacturers $500,000,000 a year!

The trouble is, in most cases, that it is a little hard to trace the savings back to the investment, the routes through which they are made being rather indirect. Thus the old-time manufacturer either refused to "throw away" good money on such "nonsense" as hiring high-salaried men to play with a few test tubes of chemicals, or, if he grudgingly spent a little on research he wanted to see the results at once. Nowadays, however, only a few hold out against the modern research trend. Research pays tremendous dividends.

WARNING

HAVE you ever noticed that the noise of a moving train is much louder when heard from the side than when heard from in front, or back of the train? The reason is probably to be found in the action of the sound waves from the various parts of the train, which interfere with one another as they flow away at right angles to the track less than when they pass down the length of the track. Recently a bus load of school children was struck at a railroad crossing. Although the driver stopped, stood on the track and listened, he was unable to hear the whistle of the approaching train, although it had been sounded. Dr. Foley, of the University of Indiana, attributes this inaudibility to the interference of the dome and the smokestack; and it is suggested that the whistle should be placed before the smokestack and in front of a parabolic reflector, to concentrate the sound and project it to the front. The idea is worth careful study and experiment by railroad officials, who are as anxious to avoid crossing accidents as are the drivers of motor vehicles.

OIL TIGHT
LESS FRICTION
LASTS LONGER

Action of shaft automatically filters and circulates oil to points of greatest load and friction. Complete lubrication means long life. Bearing completely oil sealed—oil cannot escape nor water enter.

This JONES-WILLAMETTE BEARING has run more than a year *without* re-oiling

Here is an 8-inch shaft, turning 240 revolutions per minute, driving a 1000 K. W. generator in one of the hydro-electric plants of the Portland Electric Power Co. Not only has the bearing shown given continuous trouble-free service since it went into use over a year ago (May 15, 1925), but excepting for the initial filling at the time of installation, with two quarts of oil, no oiling has been required.

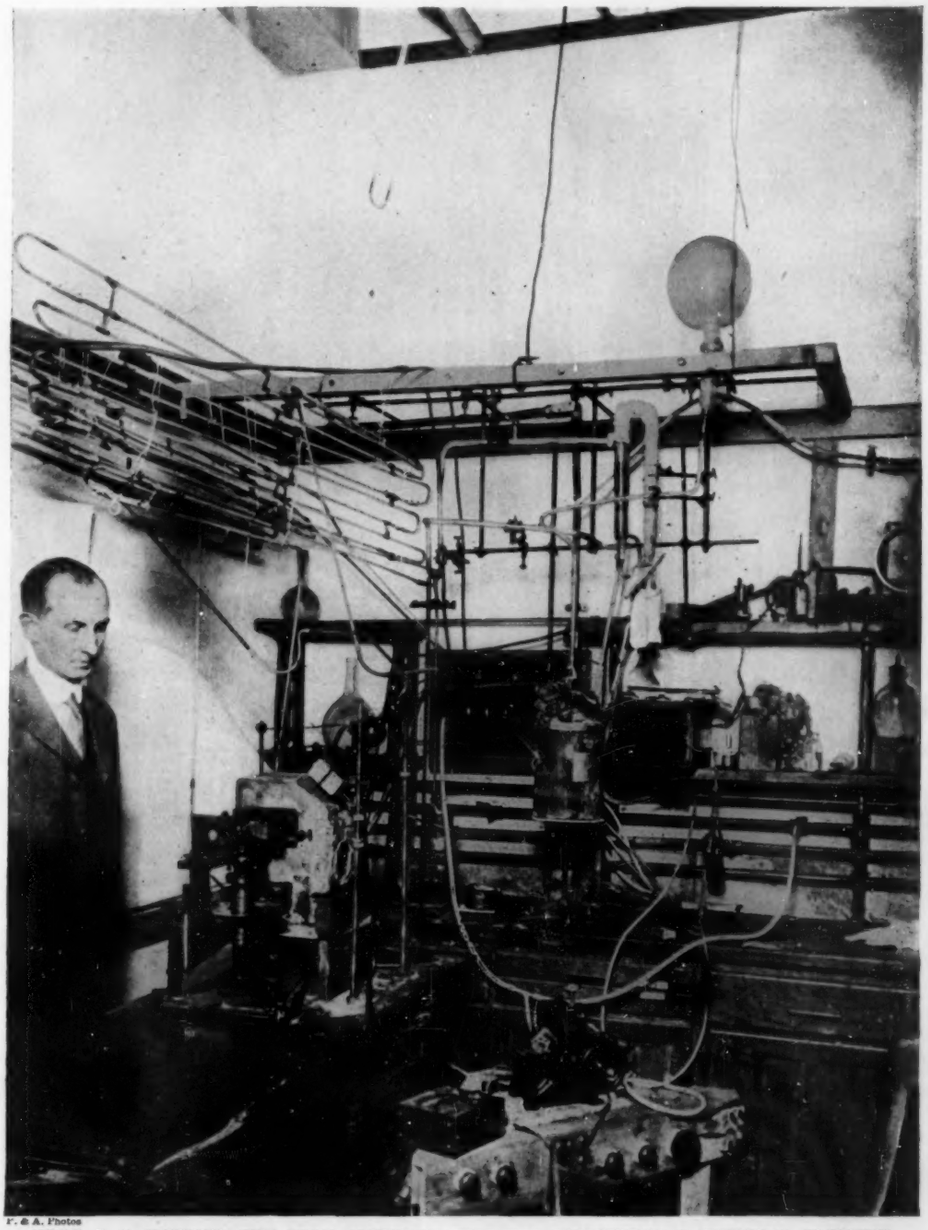
The oil-tight, automatic oil circulation principle on which Jones-Willamette Bearings are built, is the secret of the remarkable records they are making in many lines of industry. They effect remarkable savings in oil consumption, they greatly reduce power losses due to friction, they eliminate the damage to product and the fire hazard due to leaky bearings, they cut labor costs, both for oiling and service on bearings, as well as the far greater losses from forced shutdowns due to bearing trouble.

If you build machinery—if you operate a manufacturing plant—you should have full information regarding this latest development in bearings. One or two Jones-Willamette Bearings installed on your own machinery will tell you the story. Write for engineering data and descriptive literature.

Willamette Iron & Steel Works, Portland, Oregon

Monadnock Bldg., San Francisco — L. C. Smith Bldg., Seattle

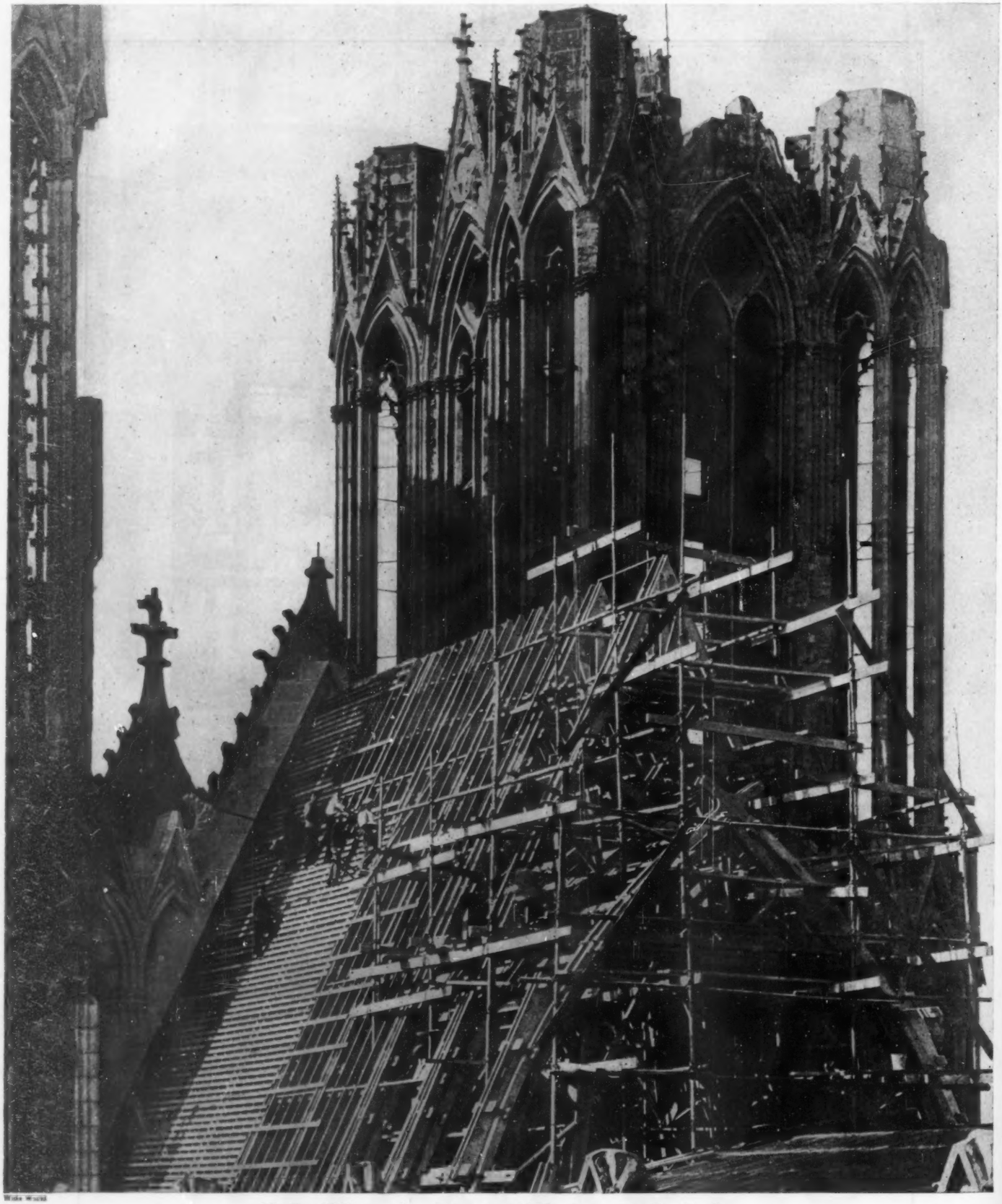
[Jones] Willamette Bearings



P. & A. Photos

PROF. B. S. HOPKINS, THE ONLY AMERICAN WHO HAS DISCOVERED A CHEMICAL ELEMENT

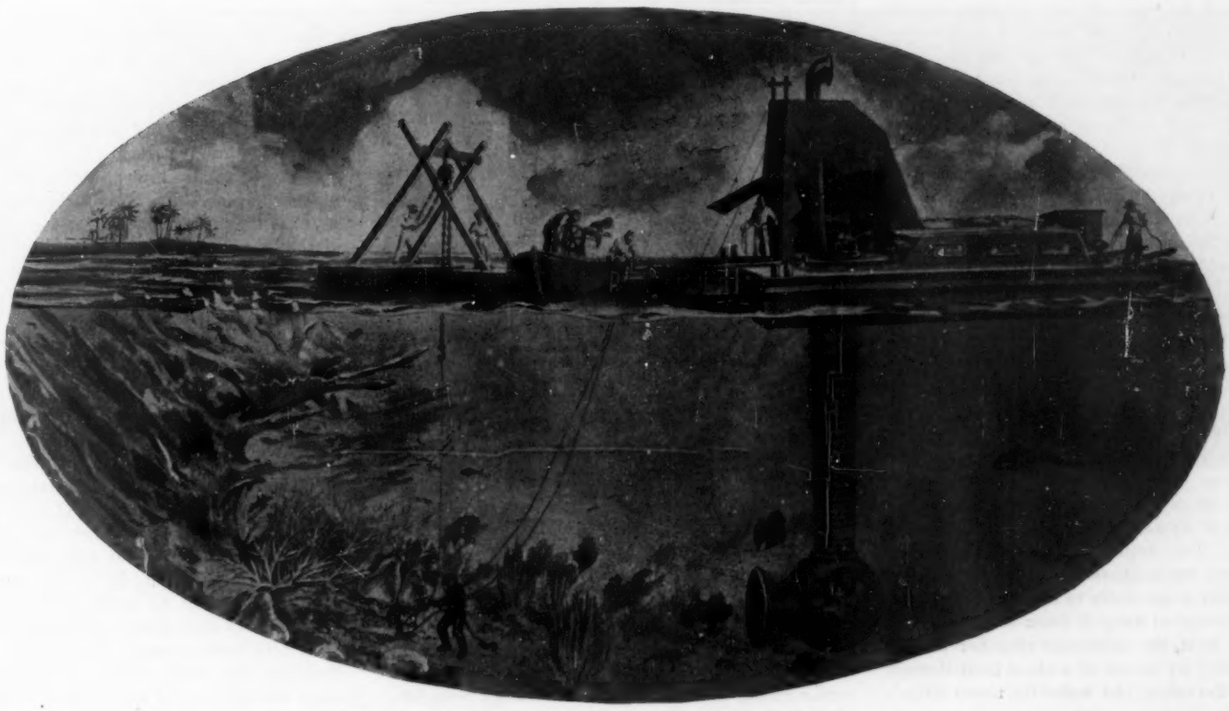
How Professor Hopkins of the University of Illinois recently discovered a new chemical element which he has named Illinum (from "Illinois") is one of the truest romances of science. Professor Hopkins did not merely stumble on illinum, nor was the search an unguided venture. Illinum had long been predicted. Mendeleeff, a Russian chemist, had arranged the known chemical elements in a sequence which strongly suggested the number and nature of those which were still missing. Moseley, a brilliant young British scientist whose life a fateful Turkish bullet extinguished at Gallipoli, formulated a rule which showed that element Number 61 had still to be identified. In monazite sands which supply the rare earths used in gas mantles, containing elements Number 60 and 62, Professor Hopkins deliberately searched. In the ultra-violet arc spectrum of these rare earths he found the predicted lines that identified the previously undiscovered element, and X-ray analysis confirmed his brilliant discovery



Wide World

Rebuilding the Roof of Rheims Cathedral

It was a conflagration, caused by shell fire, that did much, if not most, of the damage to Rheims Cathedral. The outer timber roof was entirely consumed. The old medieval roof was built of massive rafters, heavily braced together. Its purpose was to protect the stone groining (arched ceiling) from the weather. The sharp pitch of the roof was for shedding the snow freely. Here we see the new and lighter roof. Note the timber arches beneath every fourth rafter for carrying the load. This method provides a lighter and stiffer roof, allowing smaller timbers to be used.



THE WILLIAMSON UNDER-SEA TUBE IN USE FOR SUBMARINE EXPLORATION

A Trip to the Bottom of the Sea

Hunting Coral and Studying the Living Beings of the Sea Floor In a Submarine Fairyland

By Ralph Waldo Miner

Curator of Marine Life, American Museum of Natural History

THE American Museum of Natural History sends its explorers to many strange quarters of the earth. Early in 1924, it gave the writer the unusual commission of making a trip to the bottom of the sea to rob Davy Jones's locker of some of its treasures, so that a replica of a living coral reef might be erected in its new Hall of Ocean Life. Out of the way places still conceal many natural secrets, and expeditions have been undertaken to wrest them from desert and jungle and other inaccessible regions of our land masses; but to penetrate the depths of the ocean and study the living beings of the sea floor is a task that presents its peculiar problems.

The Bizarre Fleet Sets Sail

However, most difficulties have their solution. So, about the middle of June of that year a strange fleet sailed out of the harbor of Nassau, in the Bahamas, bound for the remarkable coral reef that parallels the eastern shore of the Andros Archipelago.

The diversified vessels composing this fleet were strung out in a long line fastened to each other, stem and stern. First came the *Lady Cordeaux*, an ocean-going steam tug, belonging to the Bahaman government, towing behind her the *Jules Verne*, a peculiar looking craft, consisting of a barge with a long, low cabin surmounted by a turret, containing the Williamson under-sea tube, an ingenious apparatus for investigating the sea depths. Tied astern of this vessel was dragged a pontoon, consisting of two, narrow, box-like floats fastened parallel by cross-beams and spanned by a "scissors" derrick equipped with a ten-ton chain-hoist. Next came the *Standard*, a forty-foot gasoline yacht, being towed to save motor fuel; while behind her were strung out two smaller but powerful motor boats, one of them a converted lifeboat, and two dinghies.

The sun was just setting as this remarkable procession rounded the western end of New Providence Island and steamed out upon the Tongue of the Ocean. This arm of the sea, which extends between New Providence and the Andros Archipelago, is a thousand fathoms deep, and is often lashed to fury by sudden storms. Under such circumstances the coral-barriered coast to the westward is a deadly peril, and would have endangered our string of unwieldy craft, but fortunately on this night the full moon rose over a calm sea and flooded it with silver.

Our sixty-mile voyage was made in safety and at dawn we were lying outside the entrance to Mangrove Cay. Close at hand the long line of snowy white breakers marked the location of the reef, while beyond, across the strip of quiet lagoon, stretched the low coast of Andros, plumed with coconut palms and rising above the dazzling white line of sandy beach.

At the lagoon entrance the *Lady Cordeaux* dropped the tow-line and headed back toward Nassau. In the calmer waters of the lagoon it became the task of the good yacht *Standard* to take up the tow, aided by the smaller but energetic *Nautilus*. We were just in time, for now the trades began to blow in ever increasing strength as the sun rose higher. We could feel the force of the incoming waves as we sailed past the breaks in the reef, in navigating the channel of the lagoon.

At Mangrove Cay, beneath a spreading almond tree, we met the Commissioner of Andros, Mr. E. W. Forsyth, an Englishman of Bahaman birth, who rules over two thousand blacks in the name of the King of England. This gentleman courteously put himself at our disposal as guide to the tortuous channels and reefs of Andros. Through his aid and advice we took up our headquarters in the lee of a beautiful, verdure-crowned islet known as Little Golding Cay, situated on the very line of the reefs, about five miles to the northwest of Mangrove Cay.

The sheltered side of this island boasted a crescent-shaped cove with sandy beach, furnishing an admirable anchorage for our fleet. Here we established our work tents. The Museum men slept on the yacht and ate on the deck of the barge, on which was located our kitchen and the living quarters of our native crew of fourteen husky helpers.

In Cool, Waving Submarine Forests

The Museum expeditionary force consisted of the writer and three artists belonging to his staff, namely Chris Olsen, artist and modeler; Herman Mueller, a skillful modeler in glass and expert preparator of corals, and Dr. George H. Childs, a scientific artist. Last, but by no means least, we were accompanied by the well-known and ingenious expert on under-sea photography, Mr. Ernest Williamson, whose father is the inventor of the under-sea tube, the famous "hole-in-the-sea." This essential part of our equipment has been adapted by the son to motion picture photography, and, by the courtesy of the Submarine Film Corporation, of which Mr. Williamson is general manager, the entire outfit was put at our disposal under his personal direction, for the purpose of investigating the wonderful Andros reefs.

The outer side of Little Golding Cay is constantly assailed by breakers dashed against it by the steadily blowing trade winds, so that the exposed coral lime-stone is eroded into fantastic pinnacles. Immediately seaward of the islet and to the north

and south stretch the reefs. At low water the branching tips of the living coral trees are visible just breaking the restless surface. By sculling perilously close to their serrated fronds in a native sponging boat, it is possible, by means of a water glass, to look down into the sea gardens through the tops of the stony forest.

The reef grows upward from a platform of coral detritus about fifteen to thirty feet below the water surface. This irregular sea floor shelves gradually seaward for a few hundred yards and then abruptly drops, as a submarine precipice, to the bottom of the Tongue of the Ocean six thousand feet deep. It was our purpose to study the outer side of the coral barrier from this submerged platform, as well as to obtain here the specimens needed for our museum reproduction of the reef.

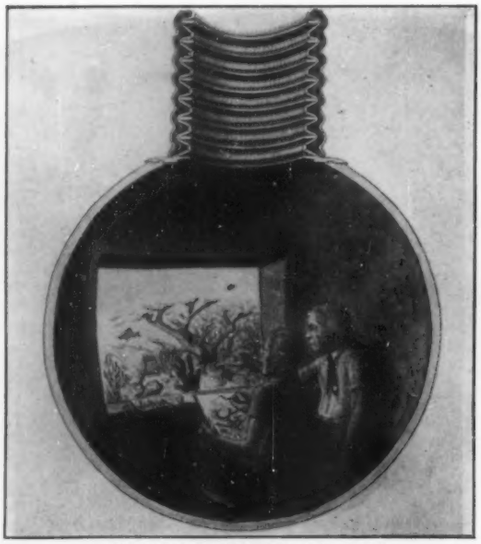
Sitting on the Floor of the Sea

On the next comparatively calm day, we towed the *Jules Verne* outside the reefs and moored it close to the front of a luxuriant portion of the barrier by means of an anchor with chain cable thrown to windward. This kept it from drifting against the reef. Two other anchors with heavy rope cables were carried out respectively to the north and south sides of the barge to keep it from swinging from side to side. Next, the submarine chamber with its tube was lowered by means of a chain-hoist through a well within the cabin, just under the tower already referred to.

The chamber is spherical in shape and about five feet in diameter, with a plate glass window an inch and a half thick. At the top of the chamber is a circular opening, to the rim of which is bolted the flanged bottom of the accordion-like tube, through which entrance is gained to the chamber. This tube is built in sections made up of a succession of flat iron rings connected together by a double layer of collapsible hinge-like links of brass. Outside the links are alternate layers of rubber and canvas, to completely exclude the water.

When the chamber was lowered to the required depth and all was in readiness, we climbed down inside the tube, using the inner edges of the rings as a ladder, until we entered the chamber. There two or three men could sit comfortably, gazing out through the polished plate glass of the window at the wonders of the deep, just as if sitting on the floor of the sea.

It was probably the first time that scientific workers had ever looked at the outside of a barrier reef from the sea bottom, and it was a sight never to be forgotten. We seemed to be looking into an enchanted forest of trees that had been turned to



A SUBMARINE ARTIST AT WORK

In the bulbous end of the under-sea tube, there is plenty of room for an artist to work or for setting up a motion picture or other camera for sub-sea photography

stone. They rose above our heads to a height of fifteen or twenty feet, their gnarled and twisted trunks giving place to densely interlacing branches, terminating in broad, spreading fronds that pierced the water-surface. Through the misty, tortuous aisles between their trunks could be seen other massive growths gradually melting into a pearly, blue haze, shot with beams of golden light made by the sun filtering between the branches above.

The sea floor at the edge of this marble forest was a complicated tangle of prostrate trunks, overgrown and surrounded by the branching, spiked antlers of thousands of staghorn corals, while here and there graceful clumps of the more delicate, finely divided fan corals gave a touch of fragile beauty to the scene. At intervals the forest growths gave way to open clearings, in which fantastic mushroom-shaped orb-corals, with stems as large as hitching-posts, dotted the sea floor singly and in clumps of two or three, their round or conical caps mottled with green and brown. Between them the ocean bottom appeared littered with piles of golden nuggets, as if a pirate ship had been wrecked here.

In reality these golden nuggets were nodular clumps of yellow *Porites* coral, lighted into gold by the dancing sunlight which penetrated the constantly moving waves and unbelievably transparent waters to illuminate the bottom with surprising effect. Here congregations of magenta and yellow sea fans bowed and worshiped in unison, as the life-giving currents from the open sea passed through their thronged multitudes, and sea plumes and sea bushes, brown, purple, and yellow, waved gracefully their finely divided and feathered branchlets.

And everywhere swarmed the fishes! Brilliantly blue *Chromis*, scintillating like sapphires in the sunlight; schools of angel-fishes, changing from blue to gold, as they passed in possession from shadowed to lighted areas; butterfly fishes fluttering in black, white and yellow clouds; jacks, barred and banded, and blueheads, brilliantly blue anteriorly, but bright green as to the rest of their bodies, looking absurdly as if they had been cut in half and matched again wrongly.

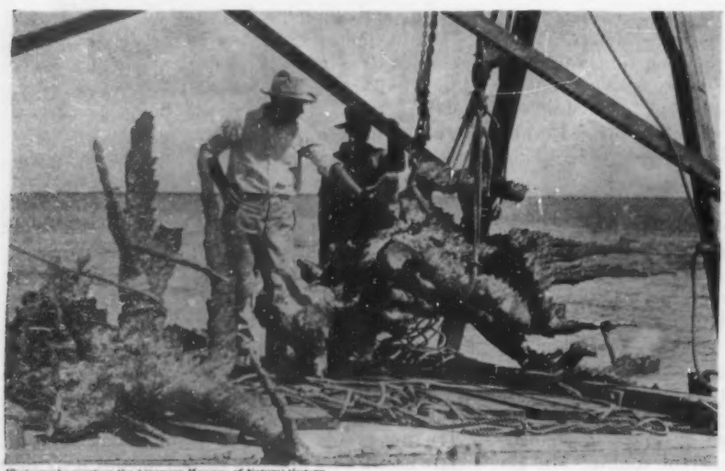
A Two-ton Piece of Coral

Now and then a grotesque trumpet fish, eight feet in length, would sail majestically past, or a heavy bodied, wide mouthed jew-fish would glower at us from between the coral trunks. Occasionally, graceful shadowy forms of sinister appearance would appear at a distance, off at one side or the other, just to notify us that sharks were present, and then our attention would be attracted to the immediate foreground as a huge green or blue parrot fish would meditatively browse among the sea fans.

Suddenly the water surface was penetrated by a strange monster coated with silvery bubbles, which, continually released, flitted to the surface in glistening clouds. A grotesque creature with huge goggle eyes glided down to the bottom and advanced toward us with half floating strides, as though equipped with seven league boots. It was Williamson, diving helmet and all, who had suddenly plunged into our fantastic world, like the genius of the place. Through the round windows of his helmet we could see his cheerful face, grinning at our surprise.

With leveled crowbar, like a lance in rest, he attacked a coral cluster, which fell at his touch. An iron basket, with rope attached, now appeared through the opaque, mirror-like surface film. This was soon heaped with choice specimens and hauled up to one of the motor boats, the bottom of which was visible above us. Larger specimens were tied to the rope, and jerked loose from the bottom. We now signed to Williamson to come near our window. By putting his helmet close to the glass, he could hear our voices. We pointed out a huge mass of palmate coral, about twelve feet in length, which we desired for the group. To secure this seemed a problem, which was finally solved as follows:

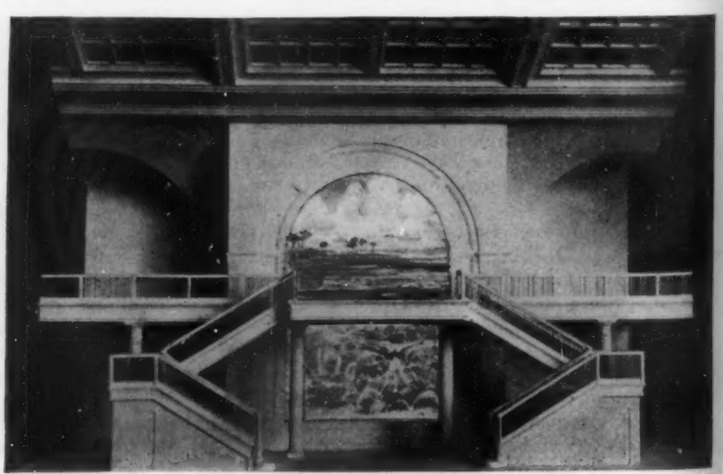
The pontoon, with the chain-hoist was anchored immediately above the coral tree, and a chain was



Photographs courtesy the American Museum of Natural History

THE SPOILS OF THE SUB-SEA EXPLORER

A strongly constructed derrick supported by two pontoons enables the explorers to raise huge pieces of coral and other specimens to the surface for future study and use



THE BEAUTY OF A CORAL BED CAPTURED

A small model of a natural size reproduction of a coral bed and its attendant sea creatures. It will soon adorn a section of the American Museum of Natural History

IN AN UNDER-WATER PARADISE

Here a diver is fastening a cable to a coral group so that it can be broken from its resting place and raised to the surface by means of a large floating derrick

DESCENDING TO THE OCEAN DEPTHS

The opening of the Williamson under-sea tube through which the explorers passed when going down to the chamber from which under-water activities were studied

lowered to Williamson, who fastened it about the trunk beneath the larger branches. A signal to the man on the pontoon, and the chain was pulled taut. A few minutes' wait and the next incoming wave lifted the pontoon and wrenched the coral loose, as if with a giant hand. It was then hauled to the surface with the hoist and placed on timbers arranged across the pontoon. Later it was found to weigh approximately two tons! In this way, during the next two weeks, specimen after specimen was secured and towed to our sandy beach on Little Golding Cay. Here they were bleached by Mueller, assisted by natives. Soon the shore was decked out in fantastic array with hundreds of snowy coral treasures, while between our tents were strung long lines of vari-colored sea fans and plumes drying in the breeze.

There were many days when we could not work outside the reef because of the strong trade winds, which drove huge rollers against it. At such times we lowered the tube in a quiet channel of the lagoon to investigate some beautiful isolated clump of coral, or sent our half-stripped native divers to the bottom for choice specimens. Our artists, Olsen and Childs, placed these in a large aquarium which we erected on the beach, and sketched their living colors.

On one occasion, however, we grew impatient, and although the sea was a little rough for comfort, dared the tube outside the reef. As we sat in the chamber, desperately photographing and sketching, and operating the moving picture camera, our spherical room bobbed and tossed with the pitching of the barge overhead. We had much ado to keep upright as the chamber banged and battered the coral heads, and broke the mushroom orbs from their stems. Finally we were forced to abandon our work lest some projecting stony branch should crash through our glass window.

Meanwhile the sea had continued to rise so that it was difficult to raise the anchors of the barge and at the same time prevent her from being driven on the reef. To cap the climax, one of the anchors caught on a ledge. So, much to our chagrin, we had to cut the cable and leave a perfectly good anchor as a memento for the mermaids. We were then towed two miles out, in order to turn in plenty of sea-room, while the crew of the barge worked like demons to raise the submarine chamber and secure it in its tower. Finally we drove straight in, ahead of the wind, negotiated the narrow channel, and were soon quietly anchored back of our islet.

Solving the Transportation Problem

One evening we had an adventure with a shark. A crew of men were going ashore in the motor lifeboat for water. It was about five o'clock and several sharks had been seen coming in from the open sea. One of the hungry monsters apparently mistook the bottom of the boat for a fish, and the moving propeller doubtless convinced him, for he made a swift dash for the stern, where, caught by the propeller, he was thrown completely out of the water and dropped back, bleeding from a huge gash under the jaw. He turned over two or three times in the water and disappeared in a pool of his own blood. In the meantime, the rudder was unshipped and the engine was stopped. Everyone in the boat felt the shock, and when the engine was started again, it was found that the propeller shaft was sprung and the stuffing-box leaked. As we had no way of making repairs, this boat was useless as a motor for the rest of the trip, although it could be towed about as a freight boat.

Our collection of corals soon became so large that the problem of packing was a serious one. It was all the more puzzling as we had no lumber and we needed soft packing to keep our heavy, fragile treasures from breaking in transport. So we sent native sponging vessels back to Nassau, whence they returned loaded to the gunwales with Georgia pine. As for packing material, we discovered a sponge house hidden among the coconuts at Mangrove Cay, where we could secure sponge clippings by the boat load. These were ideal for our purpose.

The beach was turned into a carpenter shop, as we built cases around the larger specimens, which we lashed securely in place, packing the smaller heads and clusters into the interspaces, the whole being bedded and buried in sponge clippings. When everything was finished, we had 31 cases of corals, some of huge size, and an equal number of boxes of equipment.

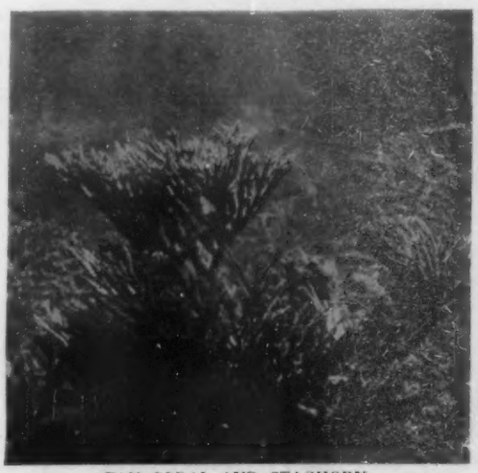
We used 2,000 feet of lumber, ten boatloads of sponge clippings, and two bales of burlap. All was then loaded on the barge, pontoon, and boats, and we were ready for the *Lady Cordeaux* to tow us back to Nassau. She was due the next day, by appointment made via a native sponger, and before daybreak her lights appeared off the reef. Our cargo was speedily towed out to her and transferred to her capacious decks by her powerful derricks. That night we returned as we had come, by full moon on a calm sea, and by dawn were calmly resting in the harbor of Nassau, whence our cargo was safely transported by liner to New York.

We had been away from the Museum but eight weeks, and we had returned with forty tons of coral for the new exhibit, for which we had important observations from life on the sea bottom, as well as 1,500 photographs, of which many were secured under the sea. There were also 2,000 feet of motion pictures, and more than 60 water color sketches showing the colors of the living corals.

Descended from a mixture of English and Polynesian stock, the residents of Norfolk Island are an interesting race. Their striking physical and other characteristics will be detailed in our September issue by Dr. H. L. Shapiro.

PALMATE CORALS

The broad branches of this West Indian coral sometimes reach a height of fifteen or twenty feet



FAN CORAL AND STAGHORN

The first, of delicate symmetry, is at the left while the second is at the extreme right

Guesswork—or Science?

The Method By Which the Scientist Locates Distant Earthquake Sources Is Surprisingly Simple in Principle

By Francis A. Tondorf, S.J.
Director, Georgetown University Seismological Observatory

THE more reliable of chronologists have computed it as probable that man has tenanted this isolated globe of ours for well nigh nine thousand years. Yet no steel has been tempered hard enough nor edged sharp enough to inflict more than a scratch on the planet's surface for the geologist to peep into.

Petty, then, as is our knowledge of the earth's interior, of one thing we are quite certain, and this is that from the very first consolidation of the crust, the earth, apparently fretful at its very existence, betrayed this anxiety in persistent tremblings.

When people became witness to these uncanny happenings, they instinctively set themselves to ferreting out what all this might mean. Particularly concerned were they to ascertain when a recurrence was likely to take place. Naturally, right here earthquake researches took a footing.

But science, without the machine, is an anomaly. Accordingly, we find that as far back as 136 A.D. (this we learn from the Chinese annals) a Chinaman, Choko by name, and by trade a smith, worked out of a lump of copper an instrument for recording the tremors of the surface of the earth. To this mechanism he, or one of his admirers, gave the name of "seismoscope."

Originated in Japan

The Chinese annals describe this assemblage of materials as follows: "The machine consists of a spherical copper vessel, the diameter of which is eight feet. It is covered at its top, and in form resembles a wine bottle. In the inner part of this instrument a column is so suspended that it may move in eight directions. On the outside of the bottle there are eight dragon heads, each of which holds a ball in its mouth. Underneath these heads are eight frogs so placed that they appear to watch the dragon's face, so that they are prepared to receive the ball if dropped. When an earthquake occurs, and the bottle is shaken, the dragon instantly drops the ball, and the frog which receives it vibrates vigorously. Any one watching this instrument can easily observe earthquakes."

Remarkable enough, in spite of the demand, no instruments were thrown into competition with this unique contraption of Choko until the year 1703, when De Haute Feuille, a French abbé, slightly modified that of our Chinese friend. From then on quite a few machines were marketed, but of these it can truthfully be said that they in nowise lent themselves to a quantitative assay of the earth's tremblors.

Just a trifle over forty years ago a quintet of English geologists, by name Gray, Perry, Milne, Shaw and Knott, made their way to Japan, where earthquakes grow over night, and there in collaboration with the native geophysicists, assembled the first of the scientific seismographs.

A Scientist in a Cassock

You read in your morning paper that a severe but distant earthquake shock has been recorded by instruments situated at some observatory. The shocks came from some as yet unlocated source, let us say, 6,500 miles away. Before the next edition of that newspaper has been issued the exact spot where the 'quake occurred becomes known. How? This is what the editor requested Father Tondorf to explain.

Father Tondorf is a priest of the Society of Jesus—the Jesuits. He is also a seismologist of note, being well-known for his researches on earthquakes. His description of the method by which 'quakes are located shows that this is not so complicated a process as many people assume.

A seismograph, as its Greek name indicates, is nothing more than a simple writing machine. To be true to its coinage, it is bonded to deliver as accurate a script of the earth's every movement as is possible. Every child who has made his initial bow to the three Rs, is aware that for writing there are three requisites—paper to write on, a point to write with, and a steady guiding hand. The paper and writing point, these are within easy reach, but the steady hand for the seismograph: there seems to be the crux of the matter. However, this difficulty is one more or less of fancy.

Many years ago, Sir Isaac Newton, he who stumbled on the laws of gravity on noticing an apple tumbling from a tree, (so the story is told) wrote a book, under the title: "Principia Mathematica." In this book, amongst other things, he pays a very uncomplimentary compliment to matter. He brands it as "lazy," although in order to say it politely he used the Latin word *iners*. Thereupon he proves it. He adds: "Every body perseveres in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed thereon."

This embodiment of passivity in matter will fill the bill. Hook a point to lazy matter and let the paper prance beneath it with the prancing earth and the seismogram is written.

Unfortunate it is that every body is in somewise bound to the earth and therefore that an unchanging state of rest is an impossibility. But in the proper suspension of the mass, where the friction is reduced to a minimum, this vitiating element is greatly eliminated. It is just a case of getting the best we can.

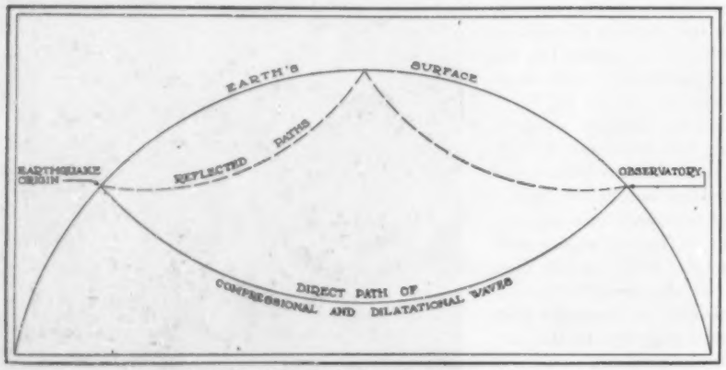
And now that the reader has been introduced to the seismologist's amanuensis, he should know something of his product. An exhibit, therefore, of a sample monograph written by this bulky amanuensis, is in order.

Earth's Topography Continually Changing

Uniquely enough, Mother Earth is ready at a moment's notice to flash her signal of distress to every nook and corner of the globe. This she does through a train of elastic waves, which, in her fretfulness, she bids hie their way along the shortest lanes through the earth's crust. It will be noted how cleverly each of these wavelets is transcribed in the accompanying graph of the 'quake of February 28, 1925, which had its center in the region north of the St. Lawrence and south of the Saguenay Rivers, and was sensibly felt throughout Canada and the entire eastern section of the United States. Particularly emphasized are the grouping of these undulations, each in turn specific, yet none repeating itself.

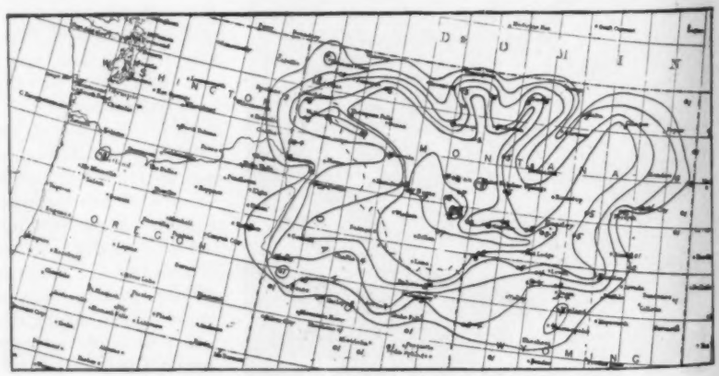
A skin-deep analysis of this script cannot but convince one of the skill of the scribe, and at the same time awaken a curiosity to know what scientific information might be coded in these alternations of ups and downs in black and white.

It is the unanimous verdict of geophysicists that all earthquakes, excepting those that take their origin in volcanic eruptions, are limited in their occurrences



HOW EARTHQUAKE SHOCKS TRAVERSE THE EARTH

From the point of origin, waves pass both through and around the earth at previously known velocities. With this information, finding the source is simply algebra



THE 'QUAKE THAT SHOOK MONTANA, JUNE 27, 1925

The lines are those of equal intensity. By this method it is possible to locate the point of origin, which is always below the surface of the earth

ANCIENT CHINESE SEISMOSCOPE

Nineteen hundred years ago a Chinese investigator made this unique indicator. When a 'quake occurred, the dragons dropped balls into the frogs' mouths

to areas of geological weakness. They are no less agreed that the topography of our planet is continually changing. Mountains are seeking the level of the sea bottoms, and sea bottoms are stretching skyward. These alternations give rise to stresses which are felt throughout the substance of the earth's structure, and sooner or later bring about fractures in the abutting zones of weakness.

Gigantic compression and distortion of the rock material follow in the wake of these breaks and from their seat, compressional and distortional elastic waves rush to the steel scribe to voice their word of protest. Interpret the arrivals of these waves at C and B in the record and you have already read much out of the monograph.

In the point of arrival it will be noticed that the compressional wave has outrun the distortional by eight seconds short of two minutes, the minutes being noted by successive indents on the line of normal travel of the 'gram. As the relative velocities of these waves are 497 and 279½ miles a minute, the computation of the distance from this lag in time is within the reach of a child of the graded schools. The problem may be thought of in this fashion: given the time of arrivals of two trains running between New York and Boston, with the trains running on parallel tracks and at the above velocities, solve for distance between these two cities.

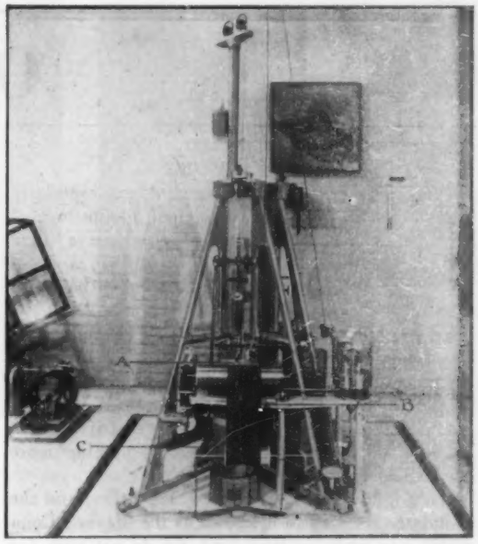
As the determination of the geographical position of an earthquake is the seismologist's chief concern, it must be clear that, although the distance may be figured out from a respectable seismogram to within a very few miles, this, by no means, dispatches the problem. The missing elements are the latitude and longitude of the center of disturbance. To ascertain these, the cooperation of other observatories is imperative. At least two, preferably more, stations are chosen, so located that arcs drawn with radii equal to the computed distances of the 'quake from these several stations will bring the arcs into intersection. This intersection fixed, the required coordinates are fixed.

Seismology Still in Its Infancy

In cases where the epicentral tract, defined by Mallet as the projection of the center of the initial displacement upon the surface, is near at hand, easier methods, although only approximate, for the determination of the focal point of the 'quake are available. The method which depends on observations of equal intensity distribution deserves note because of the possibility of its application to earthquakes of all degrees of strength. On the basis that as the result of a shock at a point in a homogeneous medium, we ought, theoretically, to obtain at points on the surface of the medium equidistant from the epicentrum, equal mechanical effects, these effects are tabulated over the entire affected area of the 'quake in terms of dislodged loose objects, fractures in buildings, and so on, and this in turn is tabulated in terms of the intensities of these dislodgments and fractures. The points of equal intensities are then interconnected by so-called isoseismal lines.

These lines, so plotted, will be found to crowd in towards a common area, known as the meisoseismal area, the area of greatest disturbance. The map of the 'quake of June 27, 1925, (presented herewith) drawn up by the United States Coast and Geodetic Survey indicates the focal point as determined by the isoseismal lines. This center actually measured up closely with that determined by the method of arcual intersection.

The science of seismology is still in its infancy. The promise, however, of an early maturity is encouraging. Today a chain of earthquake observatories encircles the globe and it is interesting to know that no fewer than thirty links in this chain are scattered over the United States. In this fact lies the assurance that a close check will be maintained on the thousands of 'quakes which, according to Dr. Sieberg of Jena, Germany, occur annually in the whole earth.

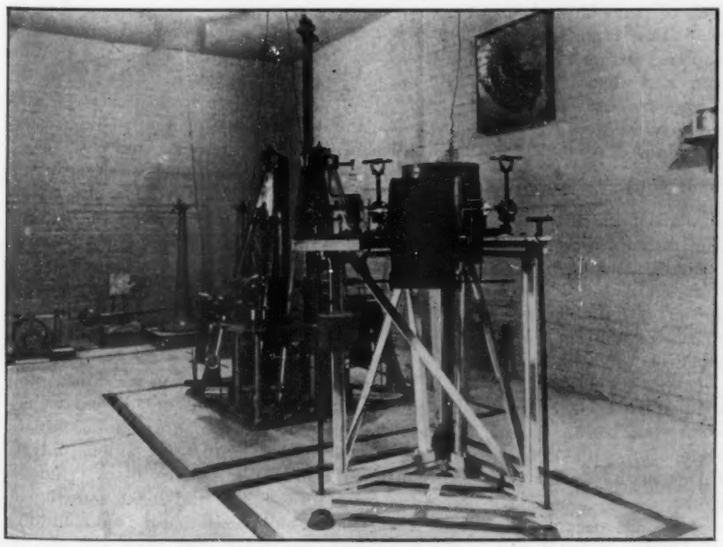


THREE ESSENTIAL PARTS OF A SEISMOGRAPH

A is the point. B is the smoked, moving sheet over which the point moves. C is the stationary mass which remains inert when the earth trembles under it

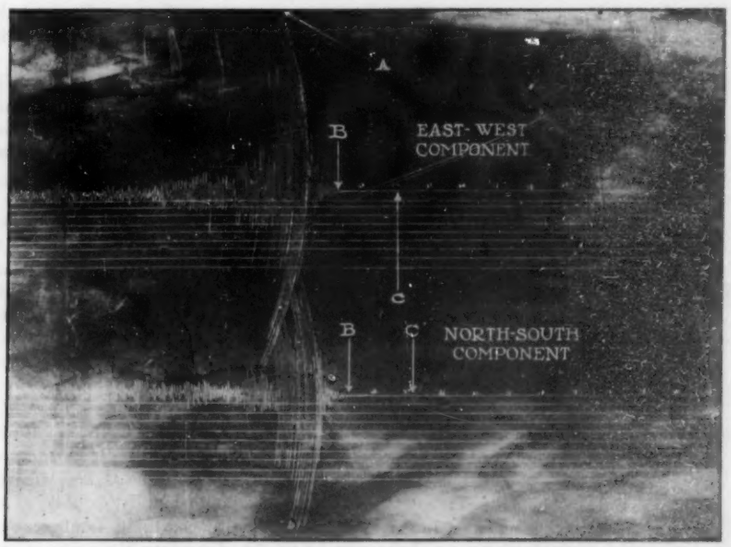
Such agencies as the British Association Seismology Committee, the International Seismological Society, the Imperial Earthquake Investigations Committee, the Seismological Society of America, the Carnegie Institution of Washington, the Geophysical Union, and the National Research Council are stimulating researches on earthquakes by material assistance. The several governments of the world have likewise subsidized these investigations. So our own government has recently authorized the conduct of similar work and has designated the Coast and Geodetic Survey to execute it.

Thus we are assured of the continued activities of the Nestors in seismology, and the newer attempts of an enthused younger generation of geophysicists. These, we are confident, will teach us to read much more out of the seismogram than we have read before, and will help clear up the mysteries of the fretful earth.



IN THE SEISMOLOGICAL OBSERVATORY AT GEORGETOWN UNIVERSITY

Three seismographs of the horizontal type—the Bosch-Omori, the Mainka, and the Weichert types—are included in the equipment. The floor does not touch their bases at any point



THE GREAT QUEBEC EARTHQUAKE WRITES ITS TREMBLING SIGNATURE

At C the compressional wave arrived. Two minutes later the distortional wave came in. From these records the distance to the disturbance was found. At A the pen left the sheet

Our Point of View

City Planning

THIS is an age of committees, especially in matters of municipal administration. When a city wishes to have a thing done, it forms a committee, and always the committees seem to be about four or five times as large as they need be. The latest example of this is the Mayor's Committee on City Planning and Survey. In one of the seven sub-committees, we are told, there are no less than 70 people.

Personally, we are of the opinion that if you can get hold of the right man, there is nothing more effective than a committee of one.

We are now speaking of New York City, and the committee referred to is known as the Mayor's Committee. In what we have said, we do not wish for one moment to be understood as criticising the move of our Mayor to straighten out the tangles, relieve the congestion of the city and reduce its chaotic conditions to a system that will be workable and economical, and will relieve the many distresses into which the citizens have fallen. Mayor Walker is doing what should have been done years ago.

It may be true, as was said of old, that "In the multitude of counselors there is wisdom," but equally true is the modern and sententious statement that "Too many cooks spoil the broth." We think that an ideal committee or sub-committee would be one composed of an engineer, an architect, a technically-trained traffic man, and a physician, each of them highly expert and with long experience behind him. The make-up of these sub-committees might be varied, probably would have to be varied, to cover the particular section of the city planning involved; but no one who has had experience in committee work will deny that four or five competent men will get more work done with less talk in a day, than a committee of 70 will accomplish in a week or a month.

Preventable Slaughter

FREQUENTLY, as the history of engineering progress proves, it has required some great disaster, involving large loss of life, to bring about improvements, particularly those which are designed to protect life and limb. It took the *Titanic* disaster to force upon shipbuilders a better system of bulk-heading and a more complete equipment of life-boats.

Let us hope that the recent ghastly rear collision between two Pennsylvania Railroad express trains will hasten the day when all railroad tracks that carry frequent and fast traffic will be equipped with that perfect protection against such disasters—the automatic stop.

Previous to the introduction of this device, the greatest protection against rear-end collisions was the block-signal system, under which no two trains can be within the same block at the same time. The block system, however, is defective in-so-far as it depends upon the human element, which, as this recent accident has shown, may suddenly cease to function. The block-signal system, considered as a piece of mechanism, is a perfect device for its purpose of preventing collisions; but since it is absolutely dependent upon the clear eyesight, close attention and instant obedience of one man, the engineer, it is to that extent a faulty system, as the recent wiping out of 15 lives and the wounding of 75 people so gruesomely prove.

The automatic stop eliminates the human element. It enables the block signal to lay its hand directly upon the throttle and the air-brake valve in the engineer's cabin. He may be inattentive, asleep, or dead; but if the semaphore arm says "stop," the electric impulse that lifts that arm will also take hold of the control mechanism of the engine and the train. The automatic stop is not a new and untested device. For nigh upon 20 years it has been guardian of the lives of the scores of millions that have traveled over the subway tracks in this city, almost from the time that they were first put in operation. Although the express trains have a speed of 40 miles an hour, and follow each other with an interval between them of less than two minutes, rear collisions never occur. Were it not for the automatic stop, there would have been a terrible list of fatalities; for the trains at times overrun the trip and are stopped. As matters stand, in respect to the number of people carried within a given time, and with a given frequency of trains, we venture to say that there is no railroad in the world whose record approaches that of the New York subways.

And it is the automatic stop that has achieved this.

The Pennsylvania Railroad system has for many a decade been considered one of the finest, best-equipped and best-run railroads in the world; but occasionally on this, as on other of our finest railroads, these fatal rear-end collisions occur. The Interstate Commerce Commission has ordered over 40 of our busiest roads to install the automatic stop and they are at work upon this very costly undertaking. Were it not that the Interstate Commerce Commission has been setting the screws altogether too tightly upon the railroads—so tightly, in fact, that only one or two of them, are able to earn the six-percent minimum of interest which the Interstate Commerce Commission considers to be only just and fair—the roads would be earning sufficient profits to be able to put in the automatic stop faster than they can ever hope to do under existing conditions. Whatever may be said about the early history of the railroads, there is no denying that during the past 25 years, and notably since the War, the Interstate Commerce Commission and the public at large have been dealing most unfairly with the railroads. No one is more eager to prevent collisions, to safeguard the lives of the passengers than are the able and far-seeing men who today are at the head of our great railroad systems. They should be given a chance to show what they can do.

For Safer Planes

The aeronautical world has been placed under great obligation to Daniel Guggenheim for his princely gift of $10,000,000 to be devoted to the development of Aircraft for general passenger and commercial travel. That the money will be spent to the best advantage is suggested by the recent offer from the fund for the Promotion of Aeronautics of prizes totaling between $150,000 and $200,000 for inventions that would increase the safety of flying. The lack of public confidence in the safety of flying is the greatest handicap to the development of passenger-carrying service on a commercial scale.

We are heartily in sympathy with this point of view. More than anything else, it is the daily record of deaths through the fall of airplanes out of control that is holding back the public. These perpetually-occurring disasters must be stopped if we are to get the American public into the air in any paying numbers, and the only way to eliminate them is by the invention of devices which will render the planes themselves inherently stable, and will enable them to regain control of themselves when stalling occurs.

Europe is far ahead of the United States in such devices. The Handley-Page slot and the Tailless airplane of which a full description and discussion by Professor Klemin appears on page 143 of this issue, have proved that the problem is capable of solution.

An Indictment of the Skyscraper

WHEN the original plans of our cities were drafted, the width of the streets was determined—if any thought was given the matter—by the expectation that they would be lined with buildings of from five to six stories in height. As long as the buildings, particularly in the business section, were restricted to such heights, there was little, if any congestion on the streets such as we experience today. But as the buildings began to increase in height, and notably after the introduction of the skeleton-steel office building, street congestion, both of pedestrians and vehicles, began to make itself felt. Today, there are long stretches of streets in some of the larger cities where from an average height of five or six stories, buildings have risen to an average height of 15 to 18 stories, with not a few structures that rise 25 and 30 stories. As between a five-story and a 30-story building, the floor space has been increased six times; that is to say, during the rush hours or at the noon hour, there are six times as many people discharged on the section of street on which the building fronts as there were under the old conditions.

We are aware that it is something like sacrilege to say anything against the modern tall building—so greatly has it been lauded on the ground of its impressiveness and magnificence, and even of its aesthetic and artistic appeal. Thus, the traveler from abroad, when he catches his first glimpse of lower Manhattan, breaks into exclamations of wonder, and in the case of some of the artistic brotherhood, it has often been spoken of as ethereal. Well, all this may be true, when, from the waters of New York Harbor or Lake Michigan, you see the skyline of Manhattan or Chicago. But when the traveler lands and finds himself jammed up in a mass of automobiles at a street corner, or jostled in a mass of city workers upon the sidewalks, he begins to realize that there are other problems of a very serious nature attending upon these Gargantuan structures.

We are suffering from congestion which is largely due to the exaggerated height of our skycrapers. Congestion must give way to distribution. If we are to have tall buildings, there should be only so many of them permitted to the city block. Judging from the present conditions and looking to the future, it must surely be realized that the mere building of new subways can never keep pace with the unhindered erection of these buildings each housing a population of a town of respectable size.

AN EXAMPLE OF ART

This bronze lion head of semihuman type is typical of Roman skill. It is but one of the ornaments rescued from one of Caligula's galleys now resting at the bottom of Lake Nemi

REMAINS OF THE TEMPLE OF DIANA

This temple was once associated with the sunken galleys of Caligula. Here were celebrated grim, mysterious rites. Excavations on this site were begun by the late Lord Savile, formerly British Ambassador at Rome

ROMAN METAL-WORK

This bronze head, suggesting the wolf of Romulus, is but a token of other treasures to be reclaimed from the galleys which have resisted every effort to raise them from the lake

Raising Caligula's Sunken Galleys

Nineteen hundred years ago, on the banks of Lake Nemi, a picturesque little lake in the Alban hills near Rome, stood the famous sanctuary and grove of Diana. It was to this pleasant refuge and to his magnificent floating galleys anchored there that the Roman Emperor Caligula repaired for an occasional respite from his life of crime in Rome. These houseboats were beautiful beyond our dreams, incrusted with marble, ornamented with precious metals and scented woods and adorned with statuary; the sails were of the finest linen and the hangings were embroidered with silver and gold.

Now, these rich old galleys lie at the bottom of the lake, where their outlines can be faintly seen on clear, still days. Repeated efforts, which date back as far as the Fifteenth Century, have been made to raise them—but all have been futile. In 1895, divers brought to the surface wooden fragments, magnificent bronze ornaments, curious relics and information concerning the structure of these vessels.

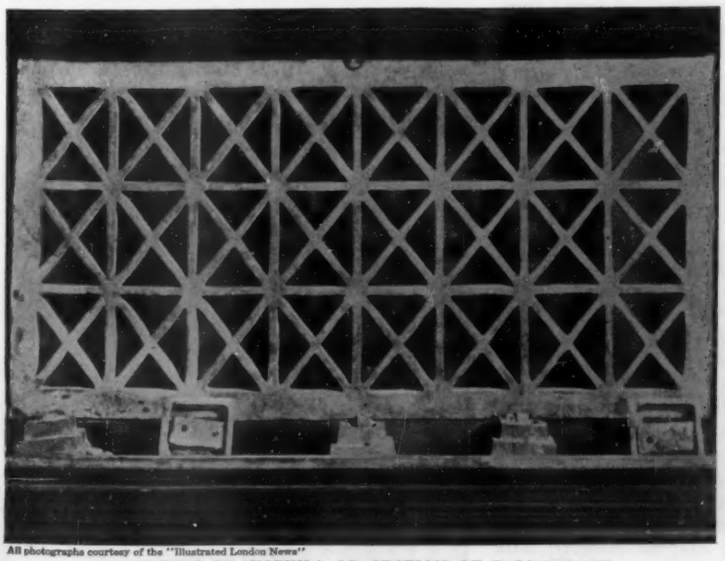
The most recent suggestion for their recovery has been to drain the lake for a temporary period by means of a tunnel or tube of discharge, to be filled and entirely stopped up at the end of the enterprise. The reclamation of these galleys would bring to light a marvel of naval construction and the highest expression of luxury.

BRONZE HEAD OF MEDUSA

This and many other elaborate ornaments not yet recovered from the sunken pleasure boats—metals, ceramics, terracottas, mosaics, altars, fountains, statues—are all indicative of the dazzling splendor which once was Rome's

A BRONZE LION HEAD

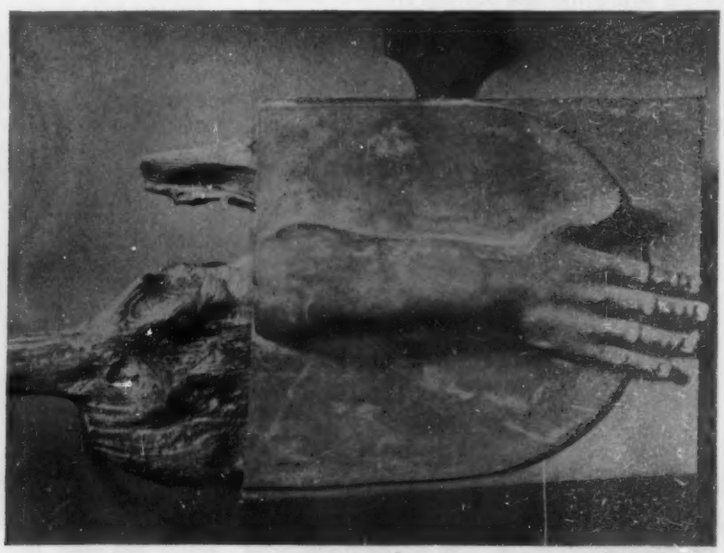
This was on one of the galleys. All kinds of curious relics have been brought up by divers. The late Lord Savile, in 1885-9, made the first excavations in the temple of Diana on the shore of Lake Nemi, near the galleys



All photographs courtesy of the "Illustrated London News"

A BRONZE *TRANSENNA*, OR SECTION OF BALUSTRADE

Although it has lain at the bottom of Lake Nemi for 1,900 years, it does not seem to be much impaired. Divers were able to draw a plan of the parts of both ships and to establish their dimensions. The larger one measures 231 feet in length by 78 feet in breadth



AN AUGURAL HAND IN BRONZE, ATTACHED TO A BEAM

The vessels are still fairly well preserved. The one nearest to the shore contains in the bulk all the machinery and the costly ornaments of the deck. It was certainly because of the enormous size and weight of these floating palaces that they did not remain long afloat

The Testimony of the Jades

The Failure to Locate the Source of the Jade Used by the Maya Indians Does Not Prove that the Mayan Civilization Was an Old World Importation

By Henry S. Washington

Petrologist at the Geophysical Laboratory of the Carnegie Institution of Washington

ANTHROPOLOGISTS now generally hold the opinion that the American Indians are not autochthonous—native to the soil—but that their ancestors came from northeastern Asia, crossing on the ice jams in Bering Strait, or by a then existent land bridge where is now the shallow Bering Sea. From the Alaskan region they gradually spread over both American continents.

Most of the tribes, scattered over North and South America, advanced scarcely beyond the hunting, or in some cases the agricultural, stage. But there developed in Middle America—a term now used to denote Mexico and Central America—a comparatively high state of civilization, as among the Aztecs and Toltecs of Mexico and the Maya of Central America.

In order to account for this remarkable local development, the hypothesis has been advanced that the culture of the peoples of these regions was modified by the influx of inhabitants of southeastern Asia, who crossed the Pacific in canoes, probably driven by storms, and who brought with them, and introduced among the Middle American tribes, something of their own culture, including jade.

Whence Came the Mayan Jade

This hypothesis rests largely on two arguments. The first is the similarity between the architecture of the Aztecs and Maya and that of Cambodia, Java, and neighboring districts: with this aspect of the problem we have nothing to do. The second argument is that jade, regarded as one of the most precious of precious stones among the Middle American Indians, is not found in place—that is, as a natural occurrence—anywhere in Mexico or Central America, although it has been searched for, while it is regarded as precious in southeastern Asia and is there found native. It is to describe American jade and set forth briefly some serious objections to this second argument that this article is devoted.

First of all: What is jade? The name is applied to the massive form of two different minerals, which, however, are much alike in their general appearance and other characters. Two scientific names—*jadeite* and *nephrite*—are used to distinguish these. Without going deeply into mineralogical technicalities, it may be said that jadeite belongs to the pyroxene group of minerals and, chemically, is a silicate of alumina and soda; whereas nephrite belongs to the amphibole group and is a silicate of lime and magnesia, often with a little iron oxide.

THE TUXTLA STATUETTE, DATED 96 B. C.
FIGURE 1: *Did the jade come from Asia, or Mexico?* INSERT: *The Mayan characters for 96 B. C.*

The two differ in other than chemical ways. Thus, jadeite jade is usually granular in structure (Figure 2) and is comparatively brittle; while nephrite jade is seen under the microscope to be a densely matted felt of minute mineral fibres. (Figure 3.) This texture renders nephrite jade extremely tough—much more so than the other.

The story goes that a dealer in minerals, who wished to break a piece of nephrite about the size of the two fists, placed it on the anvil of a large steamhammer used for forging steel. When the hammer fell, the anvil—not the jade—broke.

Another difference between the two is the specific gravity; that of jadeite being between 3.0 and 3.3, while the specific gravity of nephrite ranges from 2.9 to scarcely over 3. This difference furnishes, in many cases, the best means of distinguishing between the two minerals without injury to the object.

There are also, as a general rule, decided differences in color between the two. Jadeite is usually white or light green, and is often mottled green and white; while most nephrite is of a dark, somewhat yellowish, green. But white, jadeite-looking nephrite occurs, and some jadeite has the peculiar, dark green color of nephrite, so that these color distinctions cannot always be relied on. Jadeite is slightly harder than nephrite.

Both kinds of jade are capable of taking a very high and lasting polish, and the polished surface of both has a peculiar "feel," a character that is evident to the expert, and which is one of the charms of the material for the Chinese, or other, collector.

The high esteem, almost veneration, in which jade was held by many diverse, widely scattered, primitive peoples is very remarkable. Its recognition in the rough by the early prospectors is equally so. Jade, found or used in the earliest times only as water-worn stream pebbles, is, in the rough, mostly of a dull color and not especially attractive.

It seems probable that the use of jade came in with the introduction of the art of grinding and polishing stone tools and weapons at the close of the Paleolithic or the beginning of the Neolithic age, about 7,000 to 10,000 years ago, according to Professor Henry Fairfield Osborn.

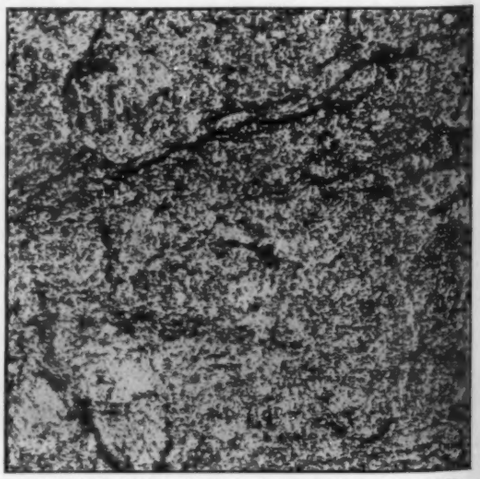
Scouting the Asiatic Theory

Before the art of grinding chipped stone was known, the unchippable jade pebble was discarded by the Paleolithic workman; whereas his Neolithic successor, attracted possibly by the green color or by some surface peculiarity, applied the new method to it. Jade was discovered, and quickly became the mode. The pleasing and unusual colors, the difficulty of working it, its toughness and high polish, and the comparative rarity of its occurrence, gave jade a preeminent value, so that it became one of the most precious of early man's materials for ornament—a position that it held for thousands of years.

And now to return to our Aztecs and Mayas. The jade-based argument for the coming to Middle America of people from southeastern Asia, it will be seen, depends on two chief postulates: (1) jade does not occur in place in Middle America, and (2) the material of the jade objects found in Mexico and in Central America is identical with the Asiatic material.

It is true that, so far, no jade, whether jadeite or nephrite, is known to occur native in Mexico or Central America, not even as stream pebbles. But the geology of large parts of Middle America is so little known that this negative argument carries small

MAGNIFIED CHIP OF THE TUXTLA STATUETTE
FIGURE 2: *Jadeite jade. Asiatic jades are of a different color*



NEPHRITE JADE—ANOTHER PHOTOMICROGRAPH
FIGURE 3: *The structure differs greatly from jadeite jade*

weight. On the other hand, several considerations lead us to the confident belief that jade does occur there and that it will eventually be discovered, most probably in both regions.

One of these considerations is that many of the worked jade objects indicate clearly that the original material was found as water-worn boulders or pebbles. This is evident either from the shape, to which the artist and the lapidary adapted the design, or from the presence of portions of the original surface of the pebble.

An interesting example in which both of these features are present is the so-called Tuxtla statuette, ploughed up in 1902 near Vera Cruz, in Mexico, and now one of the most prized possessions of the United States National Museum in Washington. This little figure, about six inches high and three

LEFT SIDE OF THE TUXTLA STATUETTE
FIGURE 4: *The inscriptions were brought out with chalk*

and one-half inches wide at the base, is composed of a pale, grayish green variety of jadeite jade. The statuette represents a priest dressed in a ceremonial bird costume. In carving this figure the Maya artist—one of great ability and with a feeling for realism rare in Maya art—has evidently been constrained to adapt his design to the shape of the boulder. Remains of the original water-worn surfaces are clearly visible on the front of this statuette (Figure 1), on the left side (Figure 4), and on the back (Figure 6).

The statuette, by the way, is of special interest as being the oldest *dated* object of native American art that is known. It is impossible, as yet, to read the Maya hieroglyphs that run vertically down the sides and back, but students of American archaeology now know very well the characters used by the Maya to express numbers and dates, so that we can interpret the hieroglyphs that appear on the front of the image. (Figure 1). These signify a date which, according to Dr. S. G. Morley, corresponds to 96 B. C., almost sixteen hundred years before the coming of Columbus.

A number of beautifully carved small figures, some of them of the most precious variety of bright green jade, have been made from flat pebbles, but were carved only on the front, leaving the original pebble surface at the back. Similarly, many of the beads, large and small, of which thousands have been found, show the irregular shape of the original pebble. Indeed, many examples are to be seen in the museums of this country and of Europe.

It is inconceivable that any people, crossing the broad Pacific, would load their canoes with pebbles, even of the precious jade, especially if they had been driven away by stress of weather.

Another fact that points to the indigenous origin of Middle American jade is that jade beads and other objects are named as among the annual tribute paid by conquered tribes to Montezuma and earlier Aztec kings. This implies a constant and fairly large source of supply over many years, a supply that a few chance canoes could not possibly have furnished. The enormous number of jade objects that have been found in Mexico and Central America points to the same conclusion.

When one remembers that, doubtless, but a small percentage of the objects have been recovered, it is evident that had the jade come from Asia many fleets of large canoes, or a long-continued system of transportation from Asia would have been necessary to supply the demand for jade in Middle America.

"Not Proved"

The tribute roll of Montezuma furnishes another feature of much interest, and probably one of practical importance. Many of the ancient towns and districts that were called on to furnish jade as tribute have been identified by Mrs. Zelia Nuttall, who finds that they are mostly in southern Mexico. Furthermore, it has been noted that, whereas strings of beads were demanded from most of the localities, "large pieces" of jade were called for from those in a certain section. As Dr. G. F. Kunz says: "Here is a well-defined region, southeast of the City of Mexico, and not far from Vera Cruz, in which the mineral must certainly exist in place." It seems more than likely that, by following up these and other such clues, jade, both as pebbles and in place, will eventually be discovered in Mexico and also in Central America. There can now be little doubt of its existence in Middle America.

We come now to the second postulate of the argument, that the American material is identical with the Asiatic. Almost all the jade, called by the Aztecs *chalchihuitl*, that is found as worked objects in Mexico and Central America, is of the jadeite variety, very few nephrite objects having come to light during explorations.

RIGHT SIDE OF THE SAME STATUETTE
FIGURE 5: *So far only the date has been deciphered*

I have recently studied many specimens of Middle American jade, with rather unexpected results. Most of the specimens examined were beads and other objects that had been thrown as offerings into a sacred well at Chichen Itza, in Yucatan, the material being kindly put at my disposal by Prof. Tozzer, of the Peabody Museum in Cambridge, Massachusetts; others came from other localities in Mexico and Central America.

The dominant colors of Middle American jade are green and gray. The green varies from a vivid pistachio-green to a very pale gray-green; the first was evidently the most valuable. The grays vary from almost white to dark gray, and some specimens are mottled in white and light green. The colors

THE HIEROGLYPHS ON THE BACK
FIGURE 6: *The oldest dated American object of art*

of the American jades, on the whole, differ decidedly from those of the Asiatic jadeite jades, the grays, especially, which are very common in America, not being found in Asia. Also the American mottled green and white differs from the similarly mottled very precious *feit-sui* of China. Again, the pure white jade, so common in Asia, is not found among the American material. The objects show a very high polish.

Study with the microscope and by chemical analysis shows that most of the American jades are mixtures of three minerals: jadeite, diopside, another pyroxene, a silicate of lime and magnesia, and a feldspar, albite, a silicate of alumina and soda, as is jadeite, but with more silica and of different crystal form. The two pyroxenes crystallize together, forming a homogeneous, new variety of pyroxene, but the feldspar crystallizes in separate crystals. The mixtures of diopside-jadeite and albite form a regular series, varying from pure pyroxene to almost pure feldspar. The green color is due to the presence of chromium.

Now, although pure jadeite occurs in place in Asia and is the material of many of the American objects, among Asiatic jades the combination of jadeite and diopside is rare, and the mixtures of pyroxene and feldspar are almost unknown.

The mineralogical and chemical evidence, therefore, is against the view that the American jade was brought from Asia.

The Fondest Dreams of the Astronomer

Things He Hopes For But Seldom Realizes. A New, Giant Telescope Is His Next Hope

By Henry Norris Russell, Ph.D.

Professor of Astronomy, Princeton University. Research Associate of the Mt. Wilson Observatory, California

THE astronomer, like other people, has his dreams. Admirable as are his best instruments, and his most favorable opportunities for studying the heavenly bodies, he always wants more—or at least wishes that still better means were available. But the form which these wishes take is not always that which the layman in the science would suppose.

Take, for example, the student of the planets, who almost alone among astronomers, except for the observers of double stars, spends his time and energy in looking directly with his telescope at the objects of his study. One would naturally suppose that what he most desired would be a greater magnifying power, so that he could get better views of the things he spends his life in studying. Ultimately, this is doubtless true, but ask him about it, and he will tell you that, under ordinary observing conditions, he does not use the highest magnifying powers of which his telescope is capable—for he would gain nothing by trying to do so. He must look through the miles of air above his head, and, since the atmosphere is never perfectly calm the images waver and dance, and too often are blurred, so that high magnifying power only magnifies the confusion. He will tell you, then, that what he really desires is "good seeing"—continuous steadiness of the image, undisturbed by atmospheric tremors.

Good seeing is a matter of climate—in a very special sense, and, before any modern observatory is located, the seeing is tested by taking a fair-sized telescope to the site and observing on not one, but many nights. A high altitude above the dense and smoky lower air, is an obvious advantage. But the top of Mount Everest would probably be an extremely poor place for an observatory, even if it could be made easily accessible, for the currents rising along the precipitous slopes would stir up a turmoil in the atmosphere and would spoil the scene. A high plateau, or a mountain top which does not rise above others in the chain is far better —and in such locations the dreams of men such as Hale or Lowell have become realities.

But it may be that the observer is concerned less with the study of fine detail than with keeping a continuous watch upon his chosen object. In this case he still seeks good weather, but his personal definition of an ideal climate is one in which it is never cloudy. In such work as the measurement of the sun's heat, where haze, as well as clouds, interferes with observation, the astronomer's dream is of a "lodge in some vast wilderness"—a high, cloudless, rainless, and if possible a dustless region. A perfectly bare rocky desert would be his ideal—barring such minor matters as living quarters.

Fixed Stars Not Quite Fixed

Dr. Abbot, of the Smithsonian Institution, has just returned from a world-wide search for such an ideal situation for making observations of the solar radiation. Arid regions in many lands were visited. More than one presented a fair approach to the desired minimum of cloudiness and moisture. But complications intervened when the dream began to take shape.*

Making the dream come true is always hard work, although it may not involve isolation in a trying climate. Consider, for example, the specialist whose field has to do with the slow motions of the stars across the heavens—the proper motions, as they are technically called. From these he hopes to find much more than is now known about the motions of the stars in space and of the sun as well. But in work of this sort, he must deal not with individuals, but with averages. Mere dozens or hundreds of stars will not suffice him. He needs thousands, and he dreams of tens of thousands as the base of his future investigations.

Thirty Years on One Problem

How shall he realize this dream? By the patient accumulation, one by one, of observations of these almost innumerable stars—getting several observations of each star, so as to have a good average—determining all the imaginable errors of adjustment of which his instrument is capable, and allowing for them—and then finding out new and previously unsuspected sources of minute error, and getting rid of these. When all this is done, he compares his work with all the observations of previous investigators—for it is only in this way that the motions of the stars can be found—and finds sometimes that he has to delve into the original records left by his predecessors, and work out the results anew. The enormous labor of such investigations can hardly be appreciated except by those who have done similar work—yet many astronomers have devoted their whole careers to this apparently dreary task and in some instances the work has been handed on from one generation to another.

But it is not only the observer who dreams dreams and sets out to make them real. We have seen one of quite a different sort come true when Brown's "Tables of the Moon" containing the results of nearly thirty years of mathematical investigation of the highest order, came from the press. This particular problem—that of calculating the moon's motion under the gravitational attraction of all known bodies—now appears to be definitely solved: but there are plenty of unsolved problems left for others to dream of.

Consider, for example, the asteroids of which more than a thousand are now known. To calculate the orbit of one of these miniature planets—as that of the moon has been computed—so that its position in the past and the future may be worked out as accurately as there is hope of observing it, is often more difficult from the mathematical standpoint than in the case of the lunar theory. Complete tables which should give the motions of all the thousand and more little planets, with this degree of accuracy, are beyond the very dreams of our present age in science—if indeed so colossal a task might not rather be called a nightmare.

But to construct approximate tables, which enable the motions and positions of these planets to be predicted for a few decades in advance, accurately enough to make sure of keeping track of them, although still a very heavy piece of work, is nevertheless possible.

The astrophysicist whose studies relate to the physical properties of the stars and whose instruments are the spectroscope, the photometer, and the thermopile, discusses one thing above all others—more light. If he is fortunate enough to be a student of the sun, he has light enough, to be sure, and so in this case his dreams are likely to be of perfect seeing. This is hard to get by day when the sun's rays heat the air—and thus this worker dreams of a telescope and spectroscope free from disturbances by the wind or by changes of temperature. These dreams again have taken form in the tower telescope.

But in the greater field which is found among the stars—not to speak of the nebulae—there is never light enough to leave a bit to spare. In spectroscopic work, for example, the star's light, when spread out into a spectrum, is practically always too faint to be studied with profit by visual observation. Photography, with its cumulative action, is unconditionally necessary.

Still more is this the case with the nebulae. The outer portions of the great nebula in Andromeda, for example, are so faint that the eye can never hope to behold them. They cover so large an area of the sky that, if they were bright enough they could be easily seen with the unaided eye. Now, an optical instrument—field glass or telescope—may make an extended object look *larger*, but it cannot make it appear brighter per unit of apparent area, nor increase the amount of light which falls upon a square millimeter of the retina of the eye. If an extended object is too faint, intrinsically, to be seen directly, it can never be *seen* at all. Here the photographic plate, with its patient continuance in summing up the action of the light makes possible what must once have seemed beyond the reach of dreams, and reveals objects that no one can ever hope to see.

The fondest dream of many astronomers, therefore, is naturally of more rapid plates, which will cut his exposure times in half—or if the dream is bold—diminish them far more. When one reads of exposures of six, ten, or even of eighty hours (continued from night to night, whenever the weather and other conditions permit) one may guess what a boon to the astronomer the discovery of a method of producing such faster plates would be.

What hope there is of the realization of this dream is still uncertain. A few years ago it was supposed that the theoretical maximum of photographic action had been nearly reached—that a single silver-grain on the plate was made developable by a single "quantum" of light energy. But recent work has proved that this is not the case, and there seems to be a wide margin for possible advance. The problem is very intricate, for the system of tiny crystals of silver bromide suspended in a colloidal layer of gelatine is one of extreme complexity from the standpoint of physical chemistry. But this leaves all the more chance open for possible progress in the future.

Chemistry Comes to Astronomy's Aid

In this case the commercial value of success would be very high, so that there is likelihood that funds for research will be available. Work is known to be going on at the Bureau of Standards, in the laboratories of the Kodak Company, and doubtless in other places. [In this as in other instances the mention of the work of American investigators must not be taken to mean that important and valuable work is not being done in other countries.] What the outcome will be only time can tell.

But do not astronomers dream, besides these things, and perhaps most of all, of greater and more powerful telescopes? Indeed they do; but this story would take longer in the telling, and we may hope to hear from it again, and soon.

* An account of Dr. Abbot's search is presented in the Scientific American Digest, on page 132.

THE FEET THAT KILL

When flies wade knee-deep through filth, these little spines gather disease germs

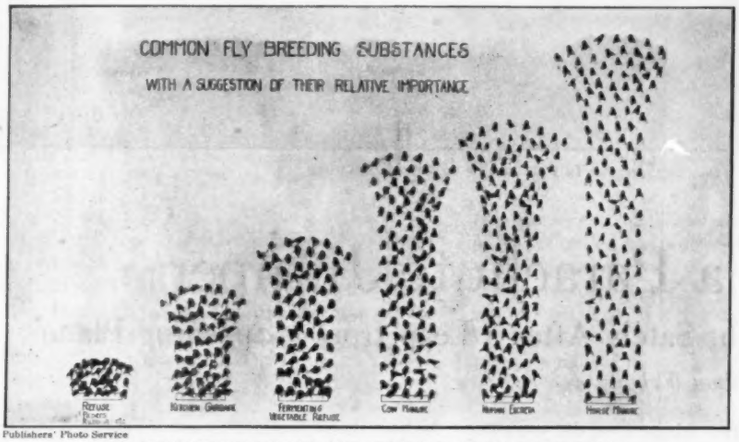
Courtesy the American Museum of Natural History

WHAT A HOUSE-FLY ACTUALLY LOOKS LIKE

His body is covered with a complete assortment of spines of various degrees of sharpness. Germs lurk among these and are dropped into our food

LIKE A SODA WATER STRAW

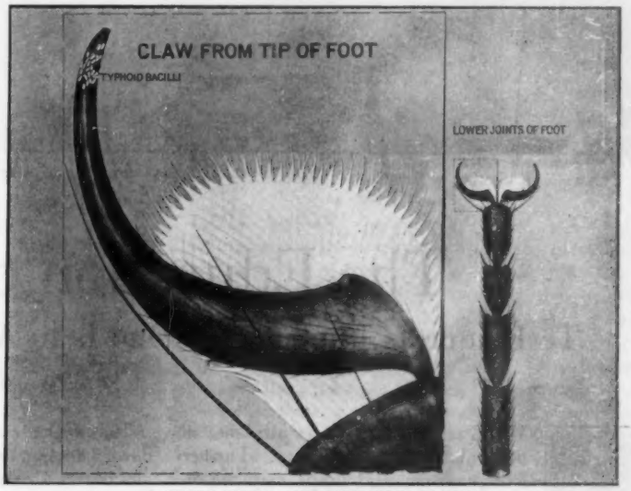
The fly's proboscis is a sucking apparatus. It cannot inject germs into us



Publishers' Photo Service

DO AWAY WITH THESE AND YOU DO AWAY WITH FLIES

Swatting flies helps, but why let them breed at all? Without the breeding places named above, flies are quite "out of luck." Manure is the worst offender

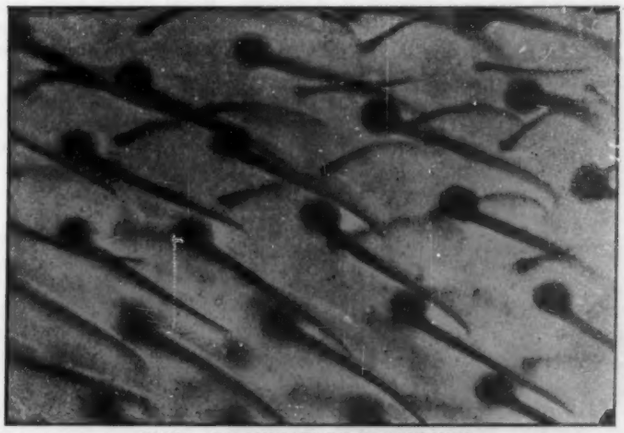


A FLY'S FEET ARE USUALLY DIRTY

When it walks on the baby's face it tracks germs after it, exactly as a boy tracks mud over a clean floor. Of these, typhoid bacillae are only one kind

THE INSIDE OF A FLY'S LIPS

An unusual picture. The diagonal division is between the lips. The tubes shown are not the tongue, as stated in another magazine

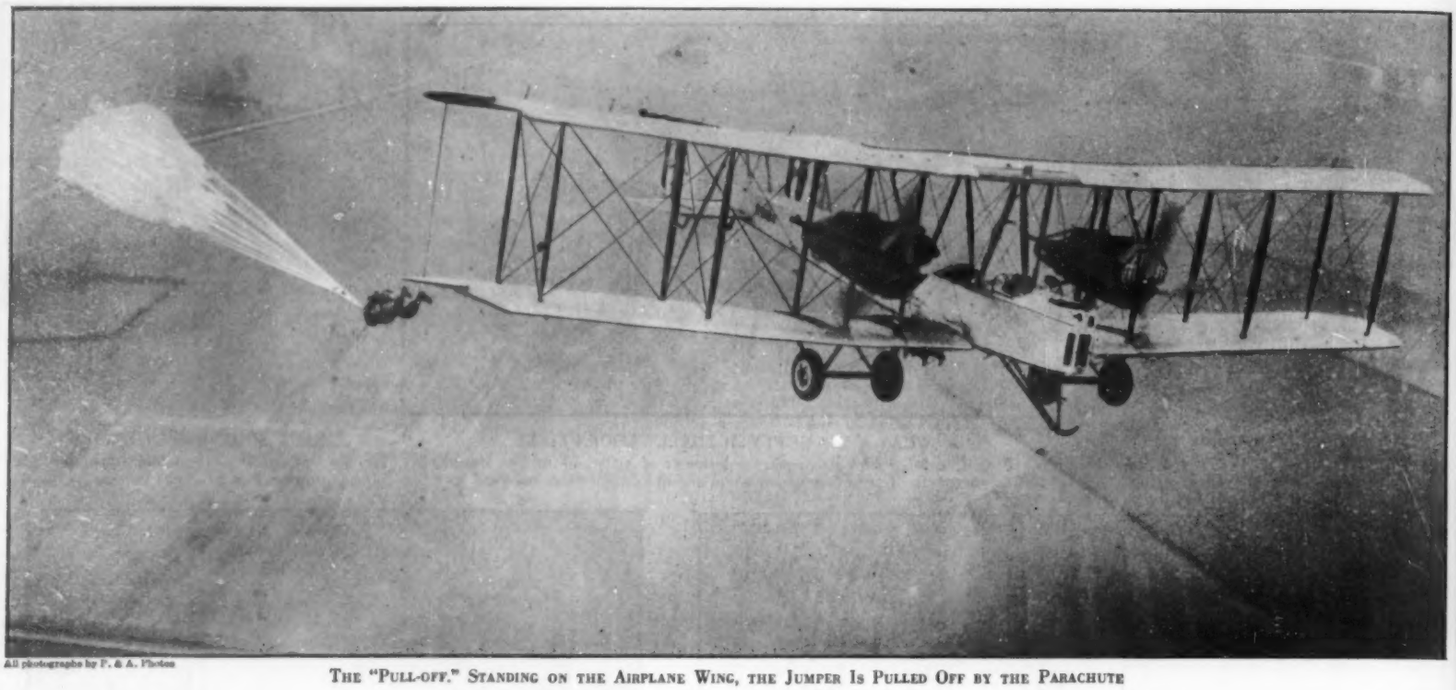


FLIES ARE MINIATURE PORCUPINES

Here is a patch of a fly's wing, magnified 500 diameters. The dim, shadowy hairs are on the under side of this thin membrane

If House Flies Were as Big as Birds

Have you ever taken a few minutes off, in order to observe closely the behavior of a common, live house-fly with regard to food? If flies were as large as birds, so that we could see their parts more clearly, we would all think more seriously about their noisome habits. Yet the fact that they are small is not significant, for they can nevertheless carry millions of disease germs on their hairy feet and bodies. Do not underestimate the house-fly because he is little. It is not, however, by a fly's mouth that germs are spread. The mouth, examined under a microscope, is a surprise. It lies between two half-oval surfaces at the lower end of its proboscis. The latter can easily be seen without a microscope, bobbing up and down, touching the food. Contrary to widespread belief there is no apparatus on the common house-fly, for penetrating the skin, even of a baby. The proboscis is merely a sucking device. Stable flies, however, have a sharp, tongue with which they suck blood, exchanging for it their own saliva.



All photographs by P. & A. Photos

THE "PULL-OFF." STANDING ON THE AIRPLANE WING, THE JUMPER IS PULLED OFF BY THE PARACHUTE

The Education of a Parachute Jumper

Technique Is Important if One Is to Alight Safely After a Leap from a Speeding Plane

By Milton Wright

ANYONE may drop from an airplane; no particular skill is necessary. Furthermore, anyone who drops may reasonably expect to arrive in due course of time at the ground. A question which then presents itself is: will you remain lying on the ground, oblivious of your surroundings, or will you lie all in one piece, rise and walk off as if nothing had happened?

THE OBSERVER'S PARACHUTE

This type does not hinder movement in the cock-pit

That depends upon two things: first, did you come down hanging to a parachute, and second, how did you conduct yourself with regard to this parachute? There is a right way and a wrong way to do everything, and parachute jumping is no exception to the rule.

In the latter part of the World War the British Royal Flying Force began to study the question of issuing to its flyers a parachute which should be an avenue of escape in times of necessity. Occasionally an aviator would be killed or injured after a collision with other aircraft; when fire had broken out in the air and it had been impossible to extinguish it, or when the plane had become uncontrollable, owing to some defect in the structure or the controlling mechanism.

Free-type Parachute Now Standard

It was found that modern parachutes fall into two classes—the static type, which depends for its operation upon a line attached to the aircraft, and the free type, which is operated either automatically or by the jumper himself, after he leaves the plane. The static type was finally rejected after trial, because the line was likely to foul some part of the aircraft and thus fail to open the parachute. By no means could this type be considered 100 percent efficient.

In the spring of 1925 the British Air Ministry decided to adopt as the standard equipment of the Royal Air Force a free-type parachute known as the Irving parachute. This had been developed by the United States Army and Navy Aviation Corps and had proved to be altogether efficient. Steps were taken accordingly to equip all Royal Air Force aircraft with this free-type parachute.

When a shipment of parachutes arrives in England from the contractors in America they are sent to the parachute testing station at Henlow, Bedford. There the parachutes, containers and harness are examined to see if they conform to the specifications. If they do, they are submitted to actual tests, for while a parachute might look all right, the question of how it will act in the air is, after all, the important thing.

Several of the parachutes are taken up in an airplane at one time for drop testing. A 200-pound weight is attached to the harness of each parachute, and in the case of every fiftieth parachute a delay

THE PILOT'S PARACHUTE

Sitting on it, his arms are free for working the controls

THE RIP-CORD RING

When the jumper pulls this ring, the pack opens and a pilot parachute is released, which pulls out the large one

REAR TRAINING PARACHUTE

For practice, two parachutes are provided, one on front and one on back. If one should fail, the other is used

COMPLETE TRAINING EQUIPMENT

The main parachute is in the pack over the stomach while the reserve one is carried strapped to the back

action is set for 500 feet, so that the release may operate under far more severe conditions than would obtain when it is in actual use. If the parachute fulfills all the required conditions, it is accepted, repacked in its container and sent to the particular flying unit which is being equipped.

In the ordinary course of flying, all pilots ascend equipped with a pilot's type parachute, and observers, air gunners and wireless operators, with an observer's type. The difference between the two is that the pilot sits on his parachute, while the observer, gunner or wireless operator wears his adjusted to his chest. The reason for this is that in the case of the pilot it is necessary to have the parachute out of the way when he is operating the airplane and engine controls. In the case of the other men, who have to move about in the aircraft, the parachute gets in his way to a less extent if it is in front of him rather than behind him.

When flyers go up in the air to practice jumping, however, two parachutes attached to the same harness are used. The reason for this is that the jumper may have a reserve parachute in case his first one fails. So far, however, it is said that there has not been a single instance when it has been necessary to use the reserve parachute.

To operate the parachute is a simple matter. The rip cord is pulled and a flap of the container, operated by means of elastic cords, opens. These cords are in tension and a small pilot parachute is ejected. This in turn pulls out the main parachute. The shock of the main parachute taking the strain of a jumper's weight is not absorbed by elastic cords, for with this type of parachute, shock absorbers have not been found necessary.

Stepping Into Space

This shock of opening, in fact, has been described as "a very pleasant jerk." And why not? Picture yourself starting to fall through the air. The little jerk, even a severe jerk, that means your parachute had opened, is a pleasant thrill you would be reluctant indeed to miss.

When it comes to practicing live drops, volunteers only are used, the Royal Air Force being unwilling to make a man jump if he does not wish to. Hitherto the demand for practice live drops by officers and men has far exceeded the facilities for giving them.

Practice is given by two methods: The "pull-off" and the "jump-off." It is advisable that the "pull-off," being less trying to the novice than the "jump-off," be practiced first.

In the "pull-off" the jumper stands on a small platform on the lower wing of a large airplane and holds on to one of the struts. When the pilot is at the right height and position to bring the jumper down to good ground the pilot gives a signal. The jumper pulls the rip cord of his large parachute. At once it opens and drags him away. If by some mischance the cord fails to open the parachute, the parachutist remains safely standing on the wing of the plane.

Slow motion pictures have been taken of the "pull-off" method. In every one of these the determination of the jumper to hold on to the strut as long as possible against the inexorable pull of the parachute may be plainly seen. To hang on as long as possible seems to be the instinct of every parachute jumper.

When the "jump-off" method is to be followed, the pilot throttles down the engine and gives a preparatory signal. The jumper climbs over the side of the airplane and descends a short ladder, holding one hand on the rip cord. He gives a nod to the pilot, who opens up his engine to increase the speed of the airplane, and steps off backward into space.

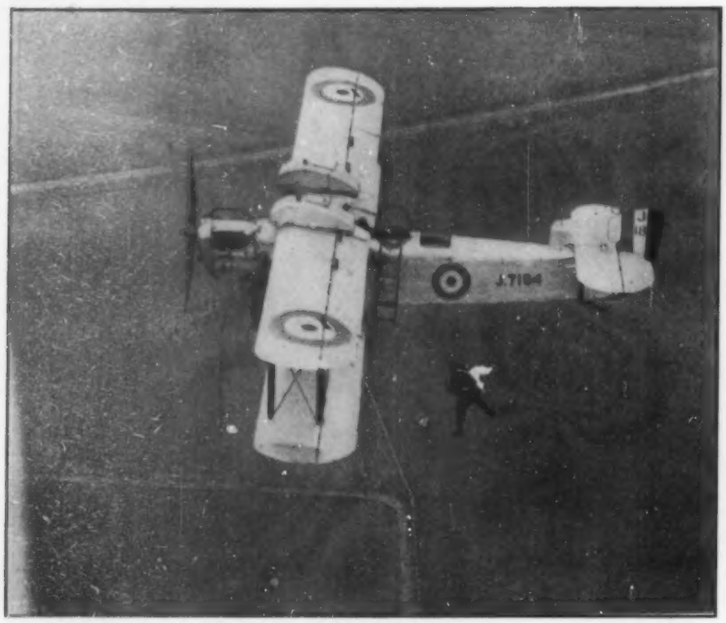
The jumper has been told to pause until he has dropped at least ten feet below the machine before pulling the rip cord. Some authorities have recom-

THE PARACHUTE PACKING ROOM

The sergeant is holding up the small pilot parachute while the main one is folded up. The pack is spread out on the table. Note complete pack at the right

TRAINING PARACHUTE PACKERS

In order to insure perfect operation of the parachute, great care is necessary in the packing. The parachutes are laid out on long tables and then carefully folded



AFTER PULLING THE RING

This photograph, taken from the air, shows the pilot parachute just emerging from the pack in response to the jumper's pulling of the ring attached to the rip-cord

SUPREME CONFIDENCE

This is what the jumper must have in his parachute if he is to drop from a speeding airplane and trust to the proper opening of his aerial life-saver

mended that the novice jumper be told to count three before pulling the cord, but such instructions are useless, the Royal Air Force has found. An excited man may count three in the tiniest fraction of a second, and the state of mind of a novice jumper is such that he might pull the cord so soon that his parachute would foul the tail of the plane.

Just as the jumper begins to imagine his parachute has failed and he is about to look for the rip cord of the reserve parachute, he feels "the very pleasant jerk" he had almost ceased to hope for, and realizes that the reserve parachute is unnecessary. Then for a time he begins to swing like a pendulum. Soon, however, this swing damps down; if it does not do so naturally, the jumper can manipulate the cords between the parachute and the harness to assist the natural damping.

Now it is time to think about making a landing, and the jumper must so manipulate the cords of the parachute that he faces down wind. By so doing he will fall forward on his hands and knees when he strikes the ground rather than backward or sideways, or on his back or the side of his head and thus he will avoid injury.

A tree, a pond, a hedge or some other undesirable site is likely to be the spot the jumper is headed for. In this case, he may side-slip clear of the obstacle by pulling down the cords on one side of the parachute.

When the feet appear to be three or four feet above the ground the jumper pulls himself up as if he were on a horizontal bar. This greatly reduces the shock. Otherwise, the impact for a 154-pound man would be equivalent to a jump off a ten-foot wall.

Few Make This a Hobby

The jumper has one more thing to do, and that is to spill the air out of the parachute by pulling the cords on the upper side. If he fails to do this he is likely to be dragged a little after he strikes the ground.

Practice jumping, as far as possible, should take place under favorable weather conditions. It should not be done if the wind is blowing a velocity greater than 15 miles an hour. In ordinary flying, however, should a jump be necessary, the rate of the wind is of small account, for it is far better for the flyer to go down with his parachute and suffer a broken leg than to remain with his machine and suffer a broken neck.

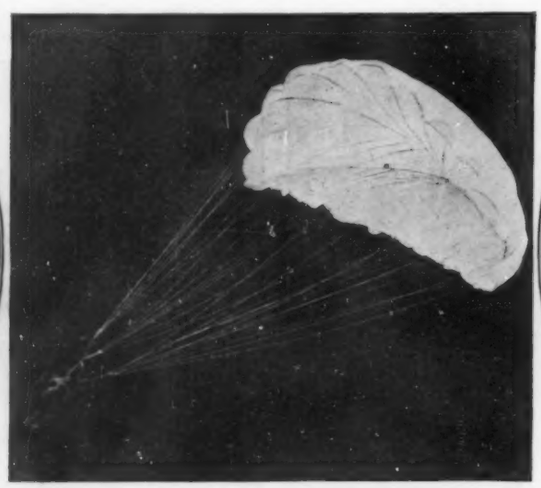
The average person is entirely satisfied with one "pull-off" descent and one "jump-off." He has gained the necessary confidence in the use of the parachute and knows that in an emergency he will have little reluctance in throwing himself out of his plane.

Small tendency, however, has been observed among average mortals to take up parachute jumping as a hobby. While it is true that the few officers directly responsible for parachute training have demonstrated drops a great number of times, they probably did it more because it is their job than because of the thrill they get out of it.

That there is a thrill, however, there is no denying but there are safer thrills to be found.

BOTH PARACHUTES OPEN

It is seldom necessary to resort to the use of the reserve parachute but it has been done as a demonstration

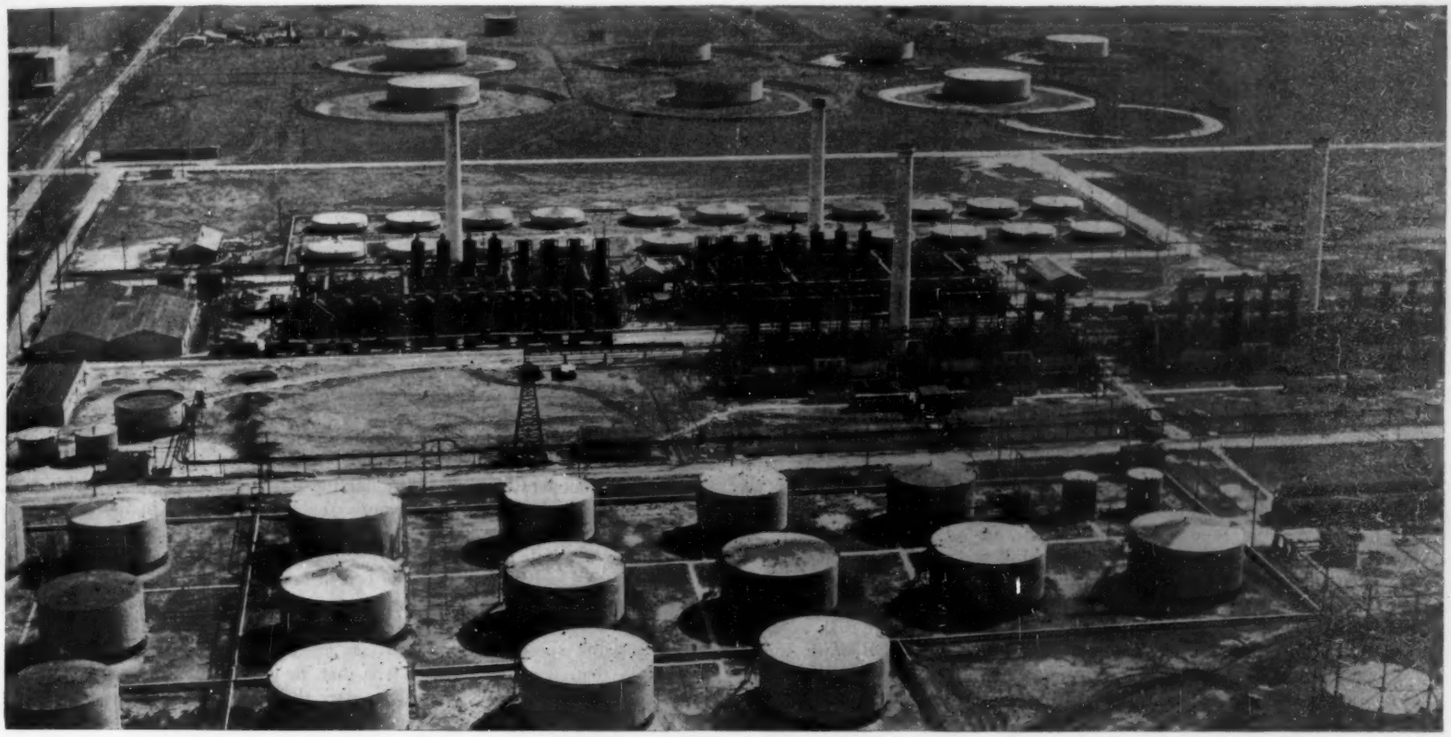


STEERING THE PARACHUTE

Pulling on the suspending ropes enables the operator to guide the parachute to effect a safe landing

A PERFECT DESCENT

Note the small pilot parachute spread on top of the main one where it fell after performing its important duty



AN OIL REFINERY AT HOUSTON, TEXAS, WHERE THE DISTILLATION OF CRUDE OIL IS CARRIED ON

Uncle Sam, Spendthrift—III

Present "Grab-all-you-can" Policy in Oil Drilling Is Criminally Wasteful. Regulated Cooperative Drilling Is Necessary to Prevent a Future Oil Famine

By J. Bernard Walker

WHEN President Coolidge appointed the Federal Oil Conservation Board, he wrote a letter which showed what a thorough grasp he had obtained of the fundamental facts which govern the demand and supply of oil. The letter opens by stating "it is evident that the present methods of capturing oil deposits is wasteful to an alarming degree, in that it becomes impossible to conserve oil in the ground under our present leasing and royalty practices, if a neighboring owner or lessee desires to gain possession of his deposits." In another paragraph, he says that he is advised that our current oil supply is kept up only by drilling many thousands of new wells each year; and that "the failure to bring in producing wells for a period of two years would slow down the wheels of industry and bring about a serious industrial depression."

Elsewhere, he refers to the fact that the production of over 300,000 wells throughout the country is in excess of our immediate requirements, and that this over-production brings down the price of oil, and this in turn leads to a wasteful and extravagant use of the oil.

It is evident from the tone of the President's letter —which, by the way, represents the attitude of many of the most experienced, thoughtful and far-seeing of our oil specialists—that he is anxious about the future of the oil industry and realizes that, although the oil resources of the United States are of vast extent, the demand for oil is growing so rapidly and the methods of recovery of the oil are so wasteful, that the country may find itself rather suddenly confronted with disaster in the shape of a positive oil famine with far-reaching effects.

Prior to the gathering of the Oil Conservation Board, the American Petroleum Institute investigated conditions in the oil industry and published a report, replete with statistics that are, of course, thoroughly reliable so far as existing facts are concerned. Our criticism of this work relates only to that part of it in which the Committee passes from facts to opinions. When the report enters the field of prediction, it seems to us that it is altogether too optimistic, and tends to lull the country and the government into an attitude of unjustifiable security as regards our future oil supply.

Are Oil Supplies Inexhaustible?

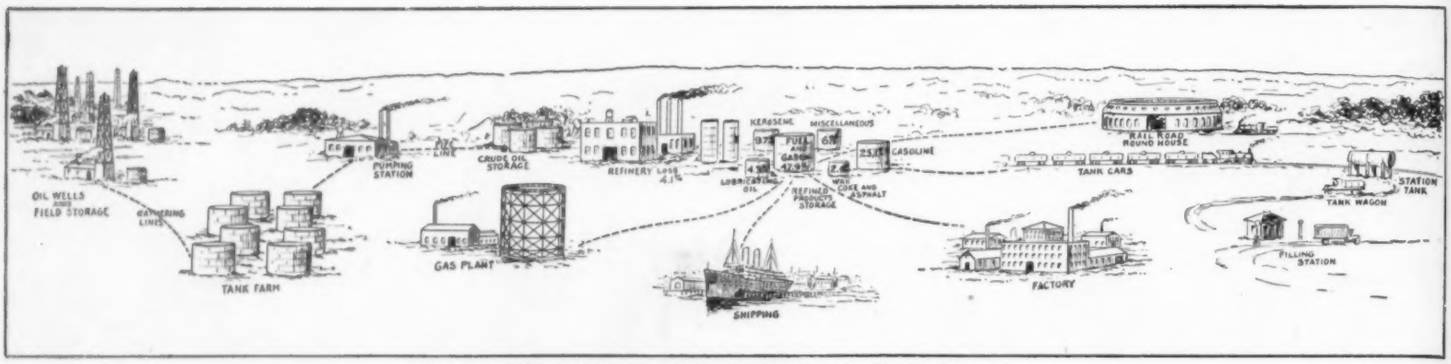
A study of the report shows that it arrives at three major conclusions. First, that our reserves of oil are practically inexhaustible; second, that though our production may fluctuate, there will be no danger of an oil famine; and, third, that there is a negligible amount of wasting of oil in the industry.

In the matter of supply, the report deals, first, with those oil reserves whose amount cannot be estimated, and, second, with those whose amount can be subjected to estimate. As regards those reserves whose oil content cannot be estimated, we read that "the greatest of the national petroleum reserves consist of 1,100,000,000 acres of as yet unexplored and unproven land inlaid with sedimentary rocks that await the drill." Under the heading "Reserves Susceptible to Computation," the report lists the present producing wells which it believes to be capable of producing, by flooding and pumping methods, 3,210,449,000 barrels of oil; and from proven but undeveloped lands it estimates a recovery of 2,110,478,000 barrels. The Institute, therefore, believes we may be certain of a future recovery of 5,321,000,000 barrels of oil from the present producing wells, and from lands which we know to contain oil but which have not yet been opened up.

In the chapter on oil in the June issue, we drew attention to the fact that only a limited percentage of the oil in the sands is recoverable by flowing and pumping, and that for every barrel of oil recovered, three barrels of oil are left in the sands. Further investigation shows that we were too conservative. It is nearer the truth to say that for one barrel recovered, four remain in the ground. Basing its calculations, evidently, upon the 80 percent of oil remaining in the sands, the Institute Committee estimates that, after natural flowing and pumping have brought up all they can, there will remain in the area which is producing and proved, 26,000,000,000 barrels of crude oil, "a considerable portion of which can be recovered by improved and known processes such as flooding with water, the introduction of air and gas pressure, and mining," and that these methods will be resorted to when the selling price of crude oil justifies the expense of recovery.

Then the report states that, when the price justifies, it will be possible to treat the vast supplies of oil shale, in which it is estimated there is a reserve of 108,000,000,000 barrels.

Should the time ever come when even the oil shales are exhausted, it will be possible to obtain from our huge coal deposits a total of 525,000,000,000 barrels of liquid products yielding 92,000,000,000 barrels of motor fuel, to say nothing of 70,000,000,000 barrels from lignite. Thus, the In-



THE DISTRIBUTION OF CRUDE OIL AND ITS VARIOUS PRODUCTS

The oil, as it comes from the wells, is first stored and then pumped to the refinery where it is distilled. The resulting oils, et cetera, are then distributed to the consumers

stitute report arrives at a grand total of future supplies of petroleum of over 734,000,000,000 barrels.

A very respectable total, were it based upon well established facts. But it is not so based; for, in spite of the high character and undoubted ability of the men who have written the report, this estimate of future recoverable oil supplies, is, after all is said and done, largely a guess.

The underlying trouble with the petroleum industry is that the law of supply and demand, which governs all other industries, is inoperative in this. But we must not imagine that any monopoly exists. Far from it. The trouble dates back to 1875, "when a Supreme Court Justice of the State of Pennsylvania, initiated that line of analogy, out of which was eventually phrased the dictum 'oil and gas belong to him who reduces them to possession.'" Had the judge followed the prevailing law regarding minerals that they were "property in place," the present disastrous methods of oil recovery might have been avoided. But since the oil as it exists in the ground is fluid, it would have been necessary to provide some method of fair distribution of the oil as it was brought to the surface, the distribution being based mainly upon the respective acreage of the various owners of the surface properties. So true is this, that today it is becoming increasingly evident to the oil industry that, for the stabilization of the industry; for the placing of oil recovery upon a practical, scientific basis; for an equitable distribution of the oil based upon surface ownership; for the elimination of the present enormous waste, both of oil and capital; and, above all, for the maintenance at all times of a generous reserve of oil, it is necessary that what has come to be known as "unit operation" be established in the industry.

In other words, cut-throat, grab-all-you-can competition must give way to mutually cooperative drilling.

Under the present methods, as we showed in the previous chapter, the work of oil recovery is being done on the principle of "first come, first served." As soon as a new well is brought in, there is an immediate rush to buy up the adjacent surface lands and drive down wells with all possible speed to tap the fruitful sands. More often than not, the free gas is allowed to go to waste; for it is the oil that the drillers are after. No effort is made to preserve the gas pressure, and consequently, only a fraction of the oil is recovered, leaving in the ground a vast amount that could have been brought to the surface if the wells had been properly spaced, as they would have been under a cooperative, unit system, and if care had been taken to maintain the gas pressure at the highest possible limit.

Eighty Percent Left in the Ground

Gas is the most important agent in the recovery of oil. From the first rush of the giant geyser to the last barrel that is brought up by pumping, it is gas pressure and gas pressure alone that is the great expelling agent.

Let us look at this all-important question more closely. The oil, as we have seen, is distributed in the microscopically small interstices of the rock sands. It is under enormous pressure and the pressure is maintained because of the strata of gas-tight rock which lie above and below the sands. A proportion, in some cases a large proportion, of the gas is free, but the greater part is condensed in the oil. Under present methods, little or no care is taken to conserve the gas, and therefore the pressure, in the sands. As the gas escapes, the ability of the remaining gas to expel the oil falls rapidly. Furthermore, the gas condensed in the oil renders it less viscous—more fluid. Oil may be so rich in gas as to be as fluid as gasoline. In this condition, it can be forced freely out of the sands; but as the gas escapes, the oil thickens and flows with increasing reluctance. It clings to the surface of the voids, and capillary restraining effects become more active. Hence it is that, under the present wild methods of operation, after the first great rush and escape of gas and oil, the yield dies away so rapidly that, when the last barrel of oil that it pays to lift has been pumped, 80 percent of the oil remains gummed up, as it were, in the sands.

Cooperative unit operation, with wells so scientifically spaced as to secure a gradual withdrawal of the oil to meet the current demands of the industry, would prevent the present wild fluctuations in the supply (and the price) and the wells, so operated, would constitute a vast reserve of known or closely known quantity.

But even with unit operation, it is doubtful whether the recovery by drilling and pumping could be much more than doubled. It is probable that 50 percent of the oil would still remain below ground. Hence, a great deal of thought has been given to the problem of recovering the oil by some more effective method, and the latest, and in our opinion the most promising plan, is that known as the Ranney Process, so named after the well-known engineer who developed it. Realizing that gas pressure is the great expelling agent, Mr. Ranney's system seeks to maintain this pressure unimpaired until all or practically all of the oil has been expelled.

THE MANIFOLD HOUSE

From this point, the distribution of the crude oil through trunk lines is controlled

THE PUMP ROOM

The oil in the refinery is in constant motion, passing through this room several times

His method is made very clear in the accompanying illustration.

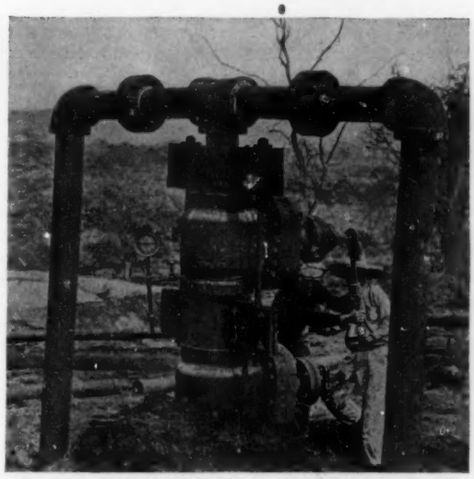
Briefly stated, Mr. Ranney's method is this: a shaft is driven down through the oil sandstone into the shale or other impervious rock below it. From the bottom of the shaft, a series of tunnels is driven through the underlying gas-tight shale. Holes are drilled at short intervals through the roof into the sandstone, and they are connected with an oil pipe-line within the tunnel. The gas pressure is maintained by means of compressed air pipes which lead into the upper portion of the sandstone. As the lower parts of the sand are drained, the oil settles down from above under the influence of gravity and air pressure. The oil pipe-line leads to a separator, which has a gas out-let pipe at the top and a water tap at the bottom. The oil is led from the separator to a vacuum pump, by which it is lifted to the surface.

The main shaft of the system is driven in the center of a 40-acre tract, which is the unit of operation. The tunnels with their mine wells are placed around the edge of each unit, and since these little oil drainage wells are spaced about ten feet apart, it follows that there are 528 wells through which the oil from 40 acres may be recovered.

Most Promising Fields Already Exploited

In view of the naval, military and industrial interests involved, it is positively appalling to realize that the oil industry is literally "living from hand to mouth." We have been using up our oil as though the supply were a mighty and ever-flowing river instead of a cistern of great but absolutely limited capacity. Nobody on earth knows how much that cistern holds. All we do know is that, under the present methods, anyone is at liberty to bore into the cistern, insert his own spiggot and draw off just as much as he can get. We do know that the great army of well-drillers carries a banner whose motto reads, "Every man for himself and the devil take the hindmost." We do know that under this wild, free-for-all scramble, the rate at which the cistern is being emptied is increasing at an ever accelerating pace.

Julian D. Sears of the United States Geological Survey, reminds us that it required forty-one years and four months to produce the first billion barrels



CHOKING OFF A GUSHER

These pipes and valves prevent escape of oil and gas

of oil; that it took only eight years and one month to bring in another billion barrels, and that only one year and seven months were required for the seventh billion to be brought to the surface. In the presence of this rate of increase, anyone who tells the American people that the cistern has practically no bottom, is doing the country great disservice and is heading the oil industry for disaster.

In looking to the future, let us keep our eyes upon well-ascertained facts. There are five states—Pennsylvania, West Virginia, Ohio, Indiana and Illinois—whose oil-bearing areas gave as rich promise for the future as does the area we have left. Nevertheless, although the rate of consumption was then but a fraction of the consumption today, these prolific fields were drained out in a comparatively few years. No one can offer a sound reason for believing that we shall get a greater proportionate yield from the oil-bearing territory which is left.

In closing this chapter, mention should be made of the encouraging fact that nearly all of the large companies have come to realize that it is absolutely necessary to check indiscriminate and wasteful drilling. Recent developments in California prove this.

Furthermore, we must remember that the areas which are known to be oil-bearing have been subjected for years to a thoroughly scientific search by an army of trained oil geologists, upon whose findings and advice the wells of the great oil companies have been drilled. Hence, it is reasonable to believe that under such exploration, the most promising fields have already been exploited and the richest pools drained away.

The fact that the supply of oil has hitherto kept pace with the rapidly increasing demand, is due to the accidental finding of some enormously rich pools, such as those in California and the midwest. Over 300,000 wells are producing about 2,000,000 barrels a day, but about 25 percent of these wells are dry holes and it is said on good authority that in the banner year–1923–over $91,000,000 was spent in drilling dry wells throughout the United States. In 1924, James McIntyre, writing in the *Oil and Gas Journal*, showed that in Kansas, Oklahoma, Texas, Arkansas and Louisiana, 4,779 test wells were drilled on untested leases, and of these, 2,382 failed to bring up any oil. In these tests, 111 counties gave 100 percent failure, represented by 225 wells, and in 29 other counties, 614 dry wells were driven, representing 73.7 percent failure. In 1924, Marland, writing in the *National Petroleum News*, stated that the American petroleum industry, since its beginning, has sold its oil for $4,900,000,000 less than it cost to drive the wells and lift the oil.

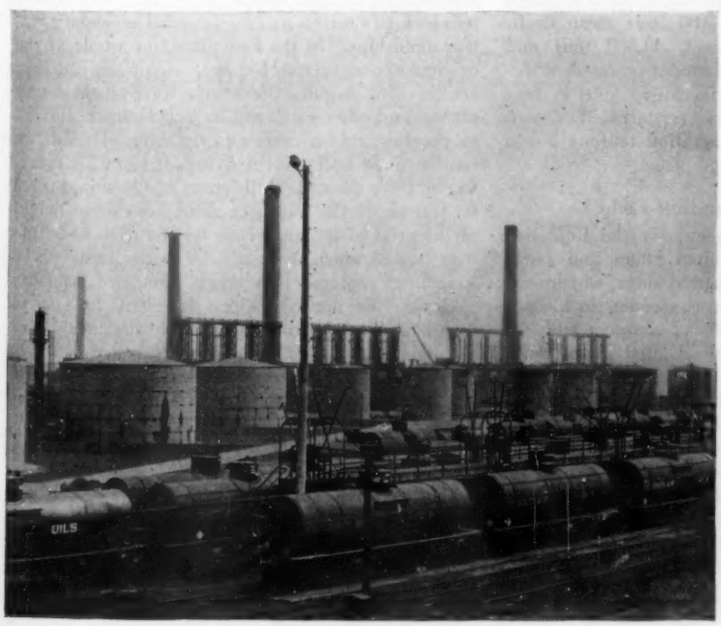
Where Is the Industry Heading?

The continuity of the oil industry is dependent upon the accident of bringing in a flood of oil from wells of enormous production. "In August, 1923," says Mr. Sears, "half of the production of the United States, or 1,000,000 barrels a day, was coming from only 3,500 wells in eight oil fields. The other million barrels were coming from 275,000 wells scattered throughout the rest of the country."

Less than two percent of the wells were yielding 50 percent of the oil.

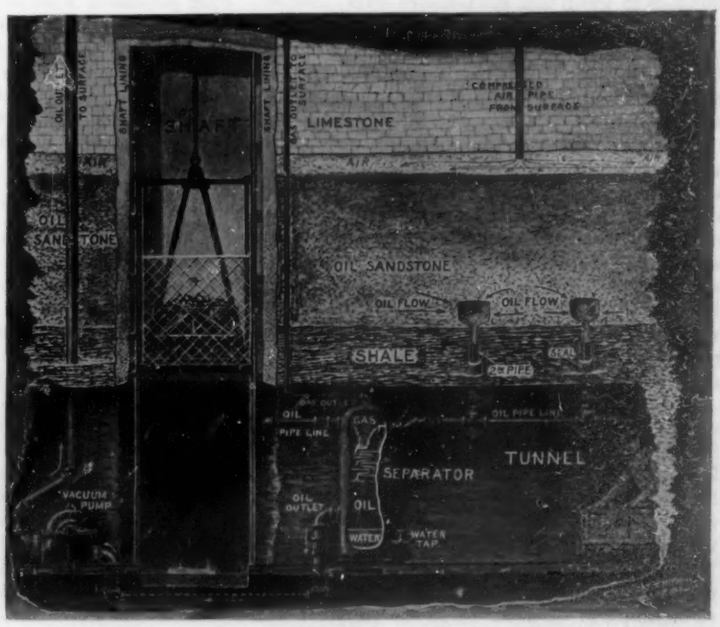
If that two percent had not fortuitously been brought in at the "psychological moment," where would our industry have been?

In our September issue we shall show how oil may be conserved by better drilling and refining, and how by using high-speed motors, 40 percent increase in automobile mileage may be secured.



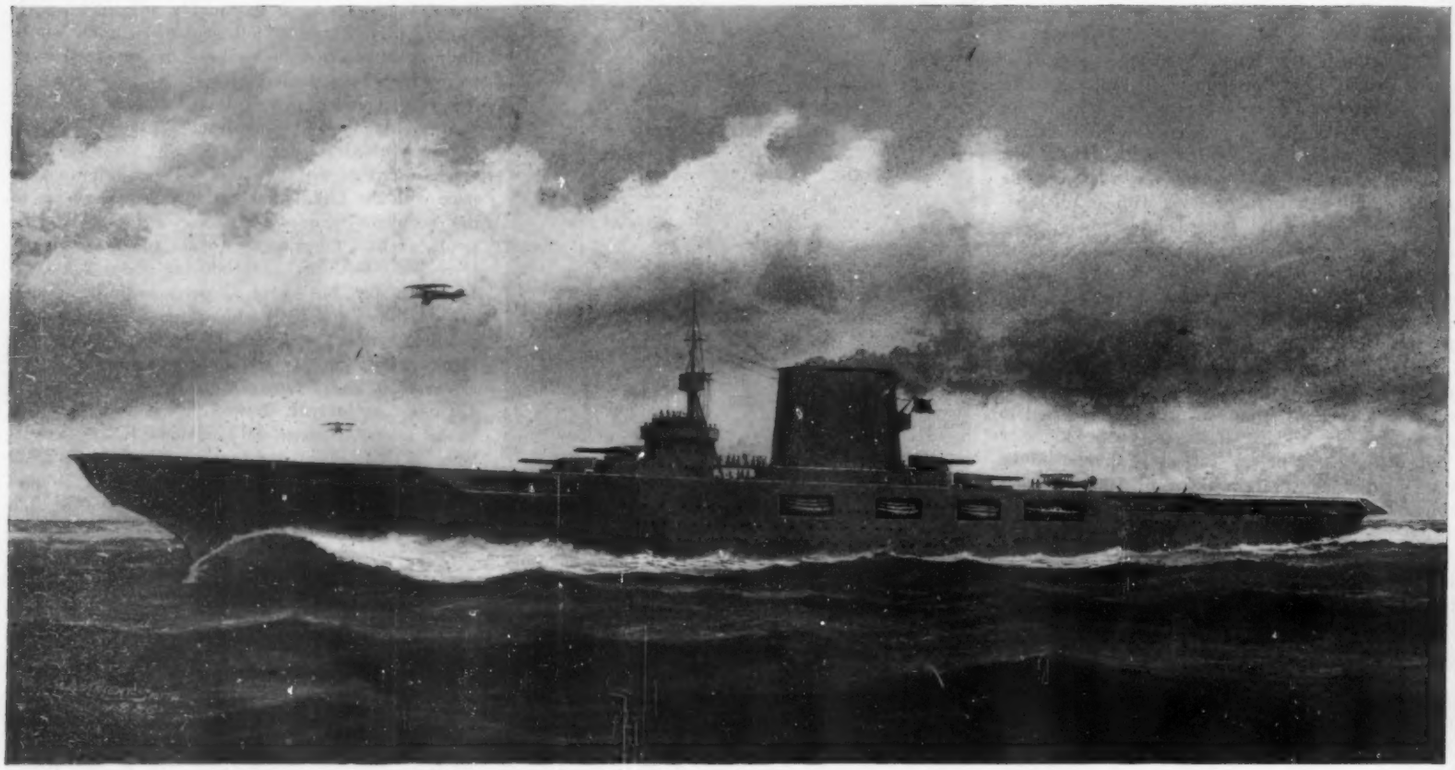
LOADING THE TANK CARS

In the background are the pressure stills and storage tanks. In the foreground is the loading rack. Note the jointed pipes used for filling the tank cars



THE RANNEY MINING PROCESS

The compressed air forces the oil from the sandstone whereupon it flows through pipes and is pumped to the surface. Notice the oil and water separator



ARTIST'S CONCEPTION OF THE UNITED STATES AIRPLANE CARRIER "SARATOGA" IN ACTION

Giant Floating Aircraft Bases

"Saratoga" and "Lexington" Are Unique in the History of Naval Construction

By J. Bernard Walker

NEARING completion at the yards of the New York Shipbuilding Corporation, Camden, New Jersey, and of the Fall River Shipbuilding Corporation at Quincy, Massachusetts, are two great warships to which that much-abused term "unique" can be applied without fear of contradiction. Aircraft carriers have been built before—lots of them—but never has there been put afloat a carrier of the combined size and speed of either of these remarkable ships.

To understand just why they are what they are, it will be helpful to give a brief résumé of their history, dating from the year 1916 when, under their original design, they were classed as battle cruisers of 35,300 tons. As such, they formed two of a squadron of six, which was part of the famous 1916 naval program. Subsequently, and because of certain lessons learned from the British navy, these ships were provided with an exterior bulge as a precaution against torpedo attack, and other changes were made which raised their displacement to 43,500 tons.

When the first designs were made public, they were subjected to severe criticism (in which the Scientific American took a rather prominent part), because of the fact that of the 24 boilers, 12 were located above the protective deck, and therefore, above the waterline, where they were liable to be wrecked by the first "straddle" of an enemy's salvo. The Navy Department realized the force of this military objection and, in the subsequent redesigning of the ships, in which the bulge and other new features above referred to were incorporated, they took the opportunity to redesign the boiler plant, substituting 18 boilers of larger capacity in place of the previous 24, and placing all of these boilers in their proper position below the protective deck and therefore below the waterline. These battle cruisers greatly exceeded all existing or proposed ships of similar types in size, speed, and gun power. The main particulars were as follows. Length on deck, 875 feet; extreme breadth, 106 feet; mean draft, 31 feet; normal displacement, 43,500 tons and speed, 33.25 knots. They carried a powerful armament of eight, sixteen-inch, 50-caliber guns in four turrets, and an anti-torpedo armament of sixteen 6-inch, 53-caliber guns, in addition to four 3-inch anti-aircraft guns.

An 800-Foot "Landing Field"

Under the Washington treaty for the limitation of naval armament, the United States and Japan were allowed to select two capital ships, which were then under construction, for conversion to aircraft carriers. The battle-cruisers *Lexington* and the *Saratoga* were selected by the United States Navy. These carriers were not to exceed 35,000 tons displacement. Accordingly, the plans were again redrawn to convert these two ships, which were already partially constructed, into aircraft carriers. Our wash drawing shows the *Saratoga* as she will appear when in service, and the accompanying photographs, taken while she was yet under construction, give an excellent impression of the characteristics of these truly remarkable sister ships. As redesigned, they measure 850 feet long on the waterline and 880 feet on deck. The extreme beam is 106 feet and the draft will be something under 30 feet.

Of the revised battle cruiser design, it may be said that all which remains is the hull and the motive power—everything else has been completely changed to meet the requirements of aircraft service. Viewed from any angle, whether abeam, ahead or astern, the ship is not now recognizable as the trim, rakish-looking battle-cruiser, with its two elliptical smokestacks, its two lattice masts, its four big sixteen-inch gun turrets and its powerful secondary battery amidships. In the first place, the whole of the original superstructure has been swept away. Gone are the 16-inch guns, the massive turrets, the heavy cranes, and other battle-cruiser accessories. Instead of the low, rakish craft as originally planned, we have a huge hull with a flying deck which everywhere, throughout the full length of the ship, towers 60 feet above the water, or nearly twice the height of the original design, whose loftiest deck had little over half as much freeboard. The two smokestacks have been replaced by a huge, elongated structure enclosing the uptakes, which is about 70 feet in length and extends about the same distance above the flying deck. To provide a clear deck for the airplanes when landing or flying off, this smokestack, together with the turrets, military mast, et cetera, has been moved over to the extreme starboard side of the ship with the result that the airmen have a "landing field" which has a clear width of between 85 and 90 feet throughout the greatest part of its length and extends unbroken by any obstruction for 880 feet. The lines of the fore deck have been swelled out in order to give greater width at the bow, the extreme end of which has been cut squarely off. This effect is seen clearly in our bow view of the ship. Towards the stern, the deck is carried out beyond the hull, and in order to prevent a low-flying or disabled airplane from hitting the

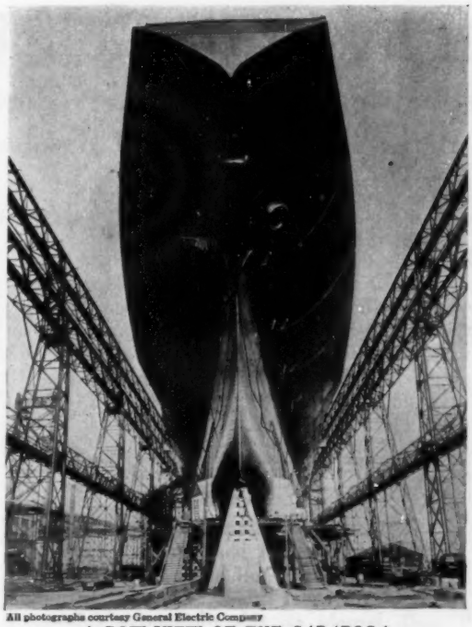
after edge of the deck, it is carried down for the last 20 feet of its length at an angle.

Ranging along the deck amidships, immediately below the flying deck, are a series of recesses within which are nested the ships' boats. Above the boats, at each end of each recess, is a horizontal davit arm, electrically operated—these arms swinging out when a boat is to be launched or recovered. The officers are berthed aft below the flying deck, and at the extreme after end will be noticed the stairway and landing by which the personnel can pass from one deck to the other.

Although these ships have lost their great 16-inch guns and their numerous battery of 6-inch guns, they are still formidable fighting craft; for their main battery consists of eight 50-caliber, 8-inch guns carried in four armored turrets. Both guns and turrets, it is needless to say, are of the latest pattern, the guns being of high velocity and great range and power. The turrets, like the smokestack, are carried close to the starboard side of the ship.

Will Carry 72 Planes

These huge ships, each carrying 72 planes will, of course, be subject to fierce attack—the very first object of attack if possible—by the enemy. Their speed will protect them against surface ships; but when the attack comes from the air, they will have to depend upon their own airplanes and upon their anti-aircraft battery. This battery is one of the finest features in the ships, for it is not only numerous but it consists of the latest type of long-caliber, high-velocity 5-inch guns, with a vertical range far exceeding the height at which any attacking planes will fly. Six of these guns are mounted forward, three on each beam, six are mounted aft, and all of them are so placed as to command an absolutely vertical limit of angular fire. The forward guns are mounted on sponsons which extend sufficiently far out from the hull to enable the guns to fire vertically without interference by the flying deck. The after guns are carried on the main deck, where the flying deck is cut away as explained earlier in the article. This anti-aircraft battery is furnished with the latest instruments for determining the height and the distance of an approaching airplane, and the mechanism is such that the elevation of the guns is automatically adjusted to keep continually trained on the airplane during its approach. Their rate of fire is very rapid and they will be able to direct such a storm of shell, that the enemy will be forced



All photographs courtesy General Electric Company

A BOW VIEW OF THE *SARATOGA*

Note the wide deck cut off square to increase space

up to an altitude at which the chances of dropping a bomb upon the ship will be very remote.

The importance of this defense can scarcely be over-estimated; for it can readily be understood that the detonation of one or two bombs on the flying deck would probably wreck it so completely as to render it an impossible surface for the flying on or the flying off of planes. This, to our thinking, is the most vulnerable feature in all airplane carriers and doubtless, in an attack, there will be many a heroic pilot who will be willing to take a chance, by diving down through the barrage in the hope of getting close enough to make sure of a hit.

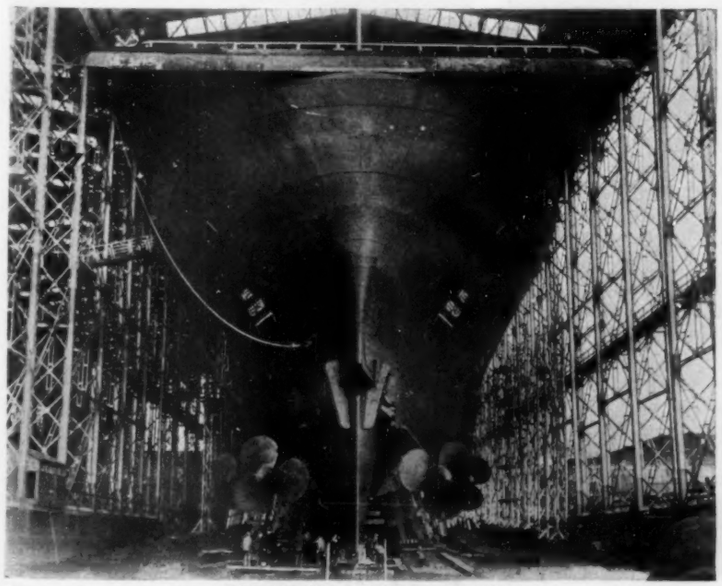
Between the smokestack and the forward pair of turrets are the bridge and the fighting mast. In these ships the lattice mast has been abandoned and the well-known British tripod mast substituted. At the top of this type is located a gun-control house, of a type generally similar to those with which the public is familiar on our battleships. On the after side of the smokestack is located a secondary gun-control house, which is smaller but similar in its equipment to the main control position on the mast. The navigating bridge, it should be explained, runs entirely around the tripod mast at about its mid-height. Above the tripod will extend the customary topmast with its yards for signaling purposes.

Before closing this description, something should be said about another remarkable feature in these ships, and that is the motive power, which is of the turbo-electric type that has been so fully tested out, with satisfactory results as to maneuvering power, in our latest battleships. In brief, it consists of steam turbines direct-connected to electric generators. The current is led through a controlling station to eight large electric motors, which are mounted, in tandem, on the inboard ends of the four propeller shafts. When it is stated that the total designed shaft horsepower of the *Saratoga* is 180,000, it will be realized that all of the various units in this power plant are of exceptional size, exceeding anything of the kind previously mounted on a ship. The electric plant would be sufficient to supply the light and power requirements of the city of Boston.

A Complete Aircraft Base

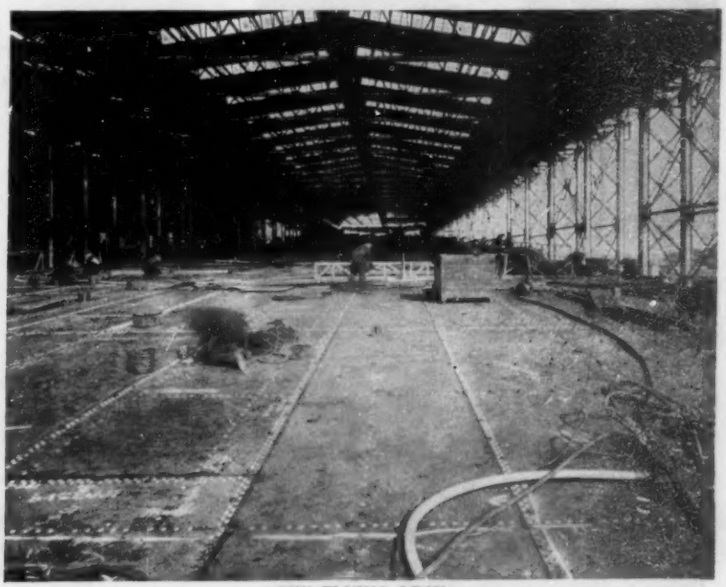
Throughout all the many changes which have been made in these ships, the power plant has remained pretty much as it was originally designed, and since the ships are several thousand tons lighter, due to the removal of heavy guns, turrets and armor, it is reasonable to expect that, on their trials, they will develop a speed of 34 knots. If so, this will put them, as far as speed is concerned, in the class with our fastest destroyers—in still water. In disturbed water when the seas run high, they will easily draw away from attacking destroyers.

It may have been noticed that in this description, we have said nothing about the interior arrangements of the *Saratoga*. This is in accordance with the wishes of our Navy Department which, like those of all other naval powers, is keeping the internal arrangements of the aircraft carriers a carefully-guarded secret. Judging from our present aircraft carrier the *Langley*, it is safe to say that the interior will provide for the storage of airplanes; space for their assembly; and elevators to bring them up, in the assembled condition, to the flying deck. There will also be the necessary machine shops and repair facilities; large tanks for the storage both of the ship's oil fuel and of the large quantities of gasoline for the supply of the airplanes. Over and above this, room must be found for berthing the crew.



THE *SARATOGA* FROM ASTERN

The great height and the rugged construction of the ship are readily seen



THE FLYING DECK

This photograph, taken in the construction shed, shows the clear sweep of the deck

The Physics of Golf Balls

Science Could Show the Sporting Goods Manufacturers How to Make Better, Faster and More Elastic Golf Balls, Tennis Balls and Baseballs—A Challenge

By H. H. Sheldon, Ph.D.

Chairman of the Department of Physics, Washington Square College, New York University

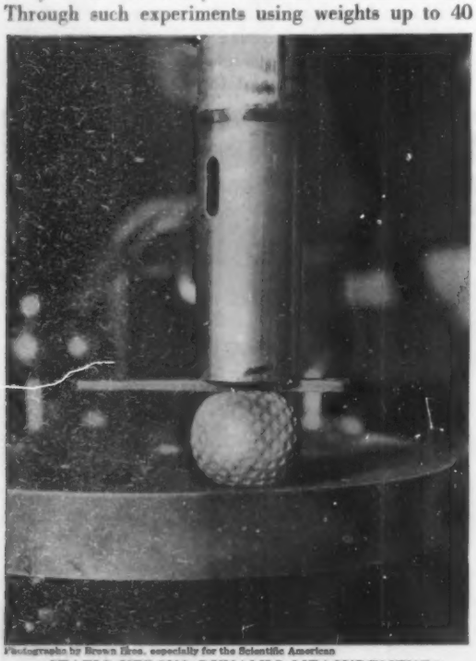
OF recent years, a great deal has been written about golf. The stance, the relative values of steel and wooden shafts, and other fine points have been discussed very fully. But the part of the game that deserves the most careful study is the ball itself.

After all, any kind of hard, heavy object will do to hit the ball with, while the man with an incorrect stance does not necessarily make the shortest drive. Given a poor ball, however, the results are sure to be poor.

Measuring the Bounce

Provided the ball is kept within the prescribed limits of size and weight, there are left but two variable factors to study, its elasticity and its surface markings. Of these, the elasticity is the simpler to test because, regardless of all sorts of fancy tests that may be devised, the only one that gives real information as to how far the ball will go when struck with a given blow is the "bounce" test. If one drops a golf ball from a given height, how far will it return? This test does not, however, measure "elasticity" in its scientific sense. Instead, it measures the "coefficient of restitution," and this is the important consideration.

It is possible to measure the elasticity of a ball by placing weights on it and noting its decrease in diameter (compression) per unit of weight added. This test flattens the ball a bit at the bottom where it touches the table and at the top where it touches the weight. It also bulges it out at the center. (Figure 1.) Obviously, the strain produced is not due to compression, shear, or stretch. Nevertheless, it is some combination of these. Therefore, elasticity of some sort may be measured in this manner. Through such experiments using weights up to 40 kilograms, the author has found, however, that there is no connection between this effect and the height of rebound after falling. That is, a poor ball may require either a greater or a lesser force to compress it a given amount than will a good ball. A poor ball is also likely to acquire a permanent "set" more quickly by this test than will a good ball, but this is not necessarily so.



Photograph by Brown Bros. especially for the Scientific American

STATIC VERSUS DYNAMIC MEASUREMENTS

FIGURE 1: *Measurements under static conditions apparently have no connection with action under dynamic conditions*

Another Alibi

Now that vacation time has arrived, Professor Sheldon has turned his attention to the lowly golf ball. He places the blame for short drives and for slice and pull, largely on this diminutive sphere. This means that it is the manufacturer of the ball who is to blame for the shortcomings of this product, for the ball itself could doubtless be improved by scientific experimentation.

In the accompanying article Professor Sheldon explains how to measure the "coefficient of restitution" of the ball. On this coefficient depends the length of your drive on the links.

Here is a new excuse for the poor golfer. The coefficients of the ball are wrong!

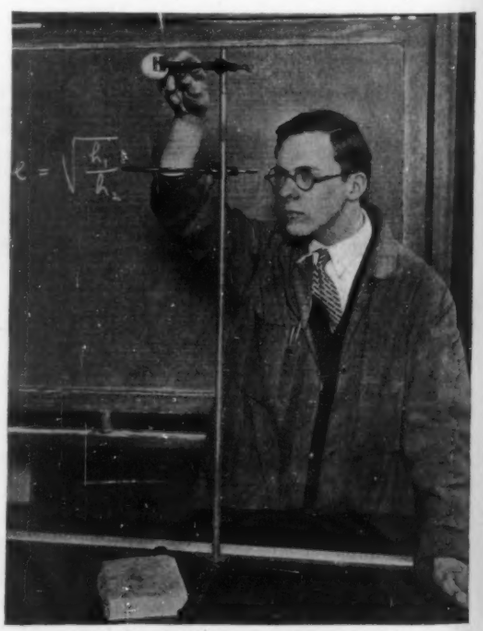
To those who are already familiar with "hardness" testing, it will be seen that the kind of test mentioned above is not very different from such a "hardness" test as, for example, the Brinell test. In this, the force required to push a steel ball a given distance into a surface is measured. This suggests, incidentally, that other kinds of hardness tests might be used for testing golf balls. Tests that were made with the scleroscope were found, however, to be of no value. In testing hardness with this instrument, a small steel "bobbin" is allowed to fall on the object and then rebound. This rebound gives a measure of the hardness. Obviously, this ought to give the same result as allowing the ball to fall on steel and itself rebound, and this result would be obtained if the ball were of homogeneous material throughout. As this is not, however, the case with a golf ball, since the bobbin is small (weight about 40 grains) only the surface material or covering of the ball is effective. The same method with a large weight would, of course, be effective, but it is obviously easier to test the ball by dropping it. Other testing devices such as the durometer and elastometer also measure properties of the surface layer only.

This rebounding property of the ball is of such fundamental importance that the coefficient of restitution should be given by the manufacturer. Fewer claims should be made without giving the information obtained by the rebound test to back them up Without going into the mathematical analysis, the coefficient of restitution, thus obtained, is found to be equal to the square root of the height from which the ball is dropped, divided by the height to which it rebounds. Stated as an equation, $e = \sqrt{h_1/h_2}$. In order to find this value accurately, the ball should be held in some sort of a release: for example, between two strip-brass springs or in a clamp, as shown in Figure 2, and allowed to drop on a hard, rigid object such as a block of iron. (Materials such as wood will dent slightly and spoil the result.) As the eye is easily deceived if the ball is not viewed strictly on the horizontal at the top of the rebound, it is necessary to use a ring and to look across its top so that both sides are seen at the same level. Its height should be adjusted until the top of the ball just shows above on the rebound. Both of the heights must, however, be taken from the bottom of the ball.

Why a Smooth Surface is Undesirable

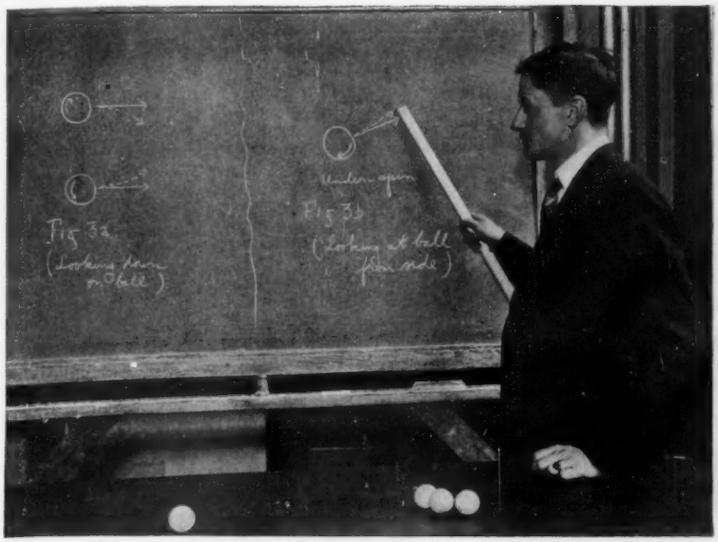
Balls measured in this manner showed a variation in the coefficient of restitution ranging from .76 to .87. It was also noticed that the poor balls fell off with increased height, which was certainly not true up to considerable heights with good balls. Of course, heights corresponding to the normal distance of flight of driven golf balls were not employed in these tests, and it would therefore be interesting to make tests at places where facilities in the form of a high tower, building, or cliff might be available. In order to be of real value, a study of this sort should be made and correlated if possible with the various constants of the pure materials (measured by such instruments as those mentioned above) which go to make up the ball. In this way, a better ball than any yet constructed might be evolved, much to the delight of the experienced and serious golfer.

With regard to the markings on the surface of the ball, much information of interest and value may be obtained. When a ball spins, due to a slice or pull imparted in the driving stroke, the friction with the air brings about a difference in pressure



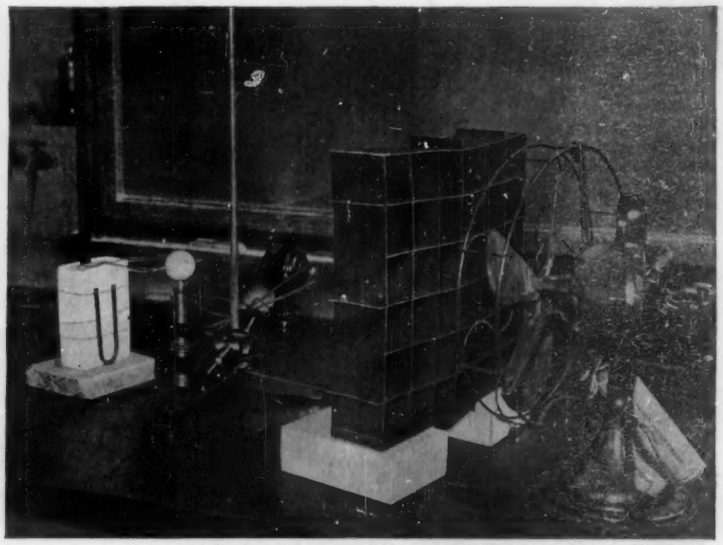
THE COEFFICIENT OF RESTITUTION

FIGURE 2: *This measurement under dynamic conditions requires no more equipment than is shown, together with the equation*



EFFECT OF SPIN ON FLIGHT

FIGURE 3, (a and b): *The solid arrows in the figures show the direction of spin and translation of the ball when in flight. The dotted arrows indicate the kind of putt that will result*



MEASURING PRESSURE DIFFERENCE

FIGURE 4: *When the ball is rotating, the liquid in the manometer is higher on one side than on the other. The "egg crate" prevents the air from whirling and affecting the results*

on its two sides (with regard to the direction of flight) and this causes it to follow a curved path either to the right or to the left, depending upon the direction of its rotation. Looking down on top of the ball during its flight (Figure 3a) the effect of this spin is shown. Obviously, the greater the friction of the surface with the air, the greater will be the deviation from the true path for a given spin.

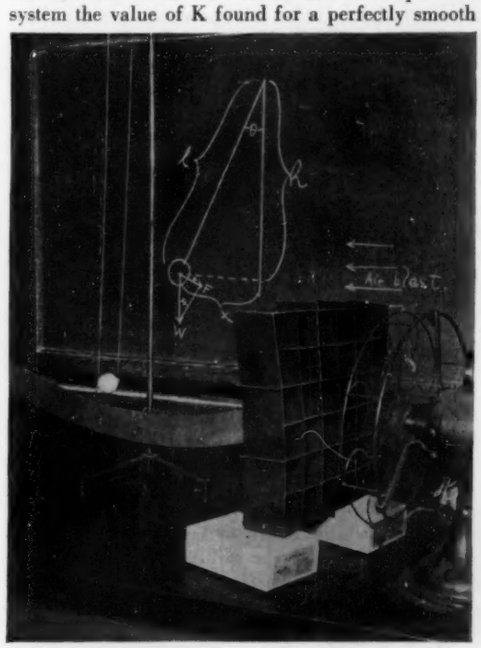
It may be asked, "Why not use a smooth surface and thus largely avoid this spin which results in deviation?" The answer is that one form of spin, an underspin produced by hitting the ball slightly below its center, is highly desirable, for this prolongs its flight. Figure 3b illustrates this spin when the ball is viewed from one side when in flight. It is necessary to strike only a very little below the center in order to give a considerable underspin. On an average drive about one-twentieth of an inch is enough. In addition to this useful underspin, in making difficult shots it is sometimes desirable purposely to use some slice or pull, thus obtaining the curved flight due largely to the effect of markings on the ball. At the same time, the friction with the air caused by a roughened surface must not be so great as to impede the progress of the ball too greatly.

Analyzing the Spin

The proper surface markings should obviously be those that will give the maximum effect due to spin, with a minimum of air resistance. At first it might seem that these two things would be the same, for the spin effect is, itself, due to air friction. It should be observed, however, that the velocity of any mark on the ball due to rotation may be quite different from its velocity due to translation through space. Coupled with this is the fact that the air resistance is roughly proportional to the square of the velocity of the ball. This results in spreading farther apart these two effects above mentioned. Further, a large portion of the air resistance is probably due to the impact of the air against the nose of the ball, whereas the other effect is due entirely to friction at the sides.

Sir J. J. Thomson has measured the difference in pressure on the two sides of a spinning golf ball. He rotated such a ball rapidly on a spindle, directing at it a blast of air, and found the pressure difference by means of a water manometer (Figure 4). He showed that the pressure difference on the two sides $(P_A - P_B) = KV_bV_s$, where K is a constant, V_b is the velocity of air, and V_s is the velocity of spin. This constant K, will obviously depend on the markings of the ball and it might well be specified for each type of ball sold. The amateur who is likely to slice badly could then give up any advantages of underspin which he is incapable of controlling and purchase a ball having a low constant K.

It is by no means a simple matter to measure K without proper tools. It would require a device such as a tachometer to measure the velocity of spin, and a pitot tube to measure the air velocity past the ball. Comparative values are easy however, to obtain. This may be done by using the same driving motor revolving always at the same speed in connection with an air blast blown from a fan through something of the nature of an egg-crate. The latter precaution is taken in order to avoid air spin. The exhaust end of a vacuum cleaner might also be used, or any other type of blower that is handy. As only comparative values are necessary, tests of this sort answer very well and we might therefore use as the unit values of our comparative system the value of K found for a perfectly smooth ball. This would at once eliminate all troublesome velocity measures.



EFFECT OF AIR FRICTION

FIGURE 5: *The greater the air friction, the farther back the ball will be driven by the action of the air blast*

It has been shown by P. G. Tait that the resistance of motion of golf balls through the air ("head-on resistance") is proportional to the square of the velocity. It seems extremely unlikely that this resistance would be affected to any great extent by the markings on the ball, although some small effect might possibly be observed. This relation between head-on resistance and velocity could be shown by supporting the ball by a long thread attached at either side and projecting a blast of air in such a direction as to cause it to swing back to a steady position, as shown in Figure 5. In such a case, the frictional force due to the air blast can be shown to be approximately $F = Wx/l$, where W is the weight of the ball, x is the horizontal displacement from the equilibrium position in quiet air and l is the shortest distance of the center of ball to the axis of support. For large deflexions (more than 5 degrees) this simple equation does not hold. So we must write $F = Wx/l \cos \theta$, where θ is the angle between the vertical and the direction of the line from the ball to the axis of support. For those who do not understand trigonometry, let me say that $\cos \theta$ in the figure is equal to h/l.

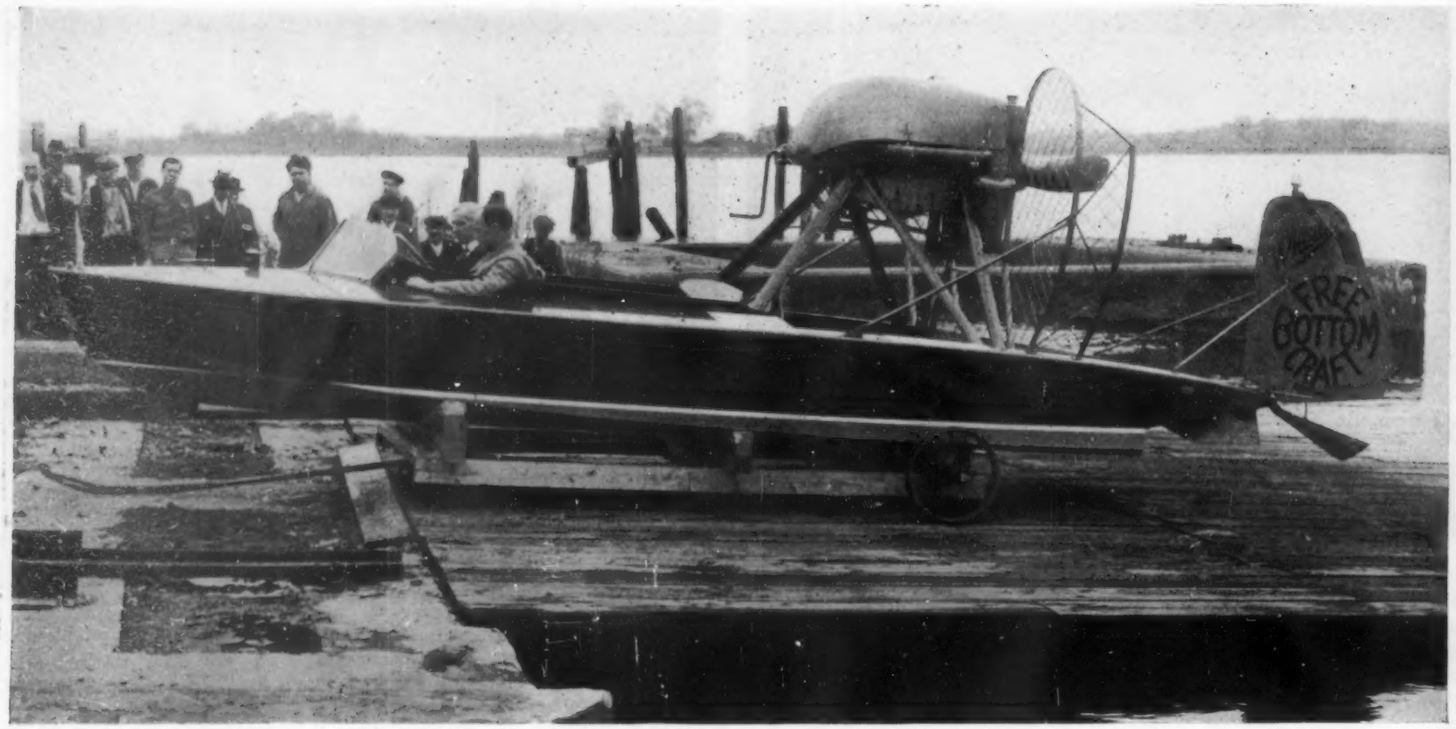
Might Measure a Pugilist's "Wallop"

These experiments, then, supply the desirable facts about golf balls. It is obvious, moreover, that similar methods can as easily be applied to tennis balls, baseballs, billiard balls, and so on. If sportsmen would interest themselves in the determination of such constants, it is obvious that the manufacture of such articles would soon be revolutionized. Standardization would be brought about to such an extent that home-run records and so on would increase from year to year.

I have suggested very briefly a few of the possible methods of experimentation. Others and perhaps better ones will suggest themselves to other minds. Perhaps, also, other subjects will occur. For example, did Jim Jeffries have a harder "wallop" in his day than Dempsey, and if so, how much harder?

Methods for measuring such things are easily available but they have not been used.

In our September issue, Professor Sheldon will present another article on simple, practical physics experiments. His scientific explanations of everyday subjects in an understandable manner are always interesting to the layman.



THE SPEED BOAT ON ITS LANDING CRADLE

The design of the hull is such that the boat draws very little water, particularly at high speed. Note the combination of aerial and water rudder that makes steering easy

Air-driven Sea Sled Has Shallow Draft

New Water Craft Will Travel 30 Miles Per Hour in Only Four Inches of Water

A "GLIDER" or "sea sled" which is an interesting adaptation of elements taken alike from aeronautics and aquatics, has been developed in the form of the so-called "free bottom" craft which we illustrate. To prove that the designation free bottom is exact, one has but to study the side view which shows an entire absence of propeller, rudder, water inlet, scoop and other appendages usual to water craft.

This novel boat is powered with a 90 horsepower Curtis motor and is steered by a combination of an air and water rudder which is supported in the blast of the eight-foot airplane propeller.

IN SHALLOW WATER

Although the water is only knee deep, note the man at the left, this water sled travels along at high speed without trouble. It is admirably adapted to shallow river travel

No claims are made of remarkable speed for her size and power although she is capable of 35 miles per hour. Comfortable speed in a useful boat, which can travel in a minimum draft of water without sacrificing the advantages to be found in her class, were the predominant ideas in her design.

Twenty-six feet over all with a beam of seven feet, four inches, the draft when loaded and at rest is nine inches. Under full speed, she actually lifts in the water till the draft is from three to four inches. Weeds and mud are not troublesome; in fact, in a pinch she can slide along on slippery mud. When placed on the handling truck, the blast of the airplane propeller will send her out of the water and up to the boathouse.

For slow navigation, the water rudder is necessary. This is so hinged that it will rise and freely pass over any obstruction over which the keel passes. As the speed of the air propeller increases, it acts on the small vanes seen on the sides of the air rudder forcing them back by a system of levers, until the water rudder is clear. Like an airplane, the craft then steers entirely by the air rudder. On turns, even at maximum speed, she heels in and runs free with her cockpit dry even in a choppy seaway. At idling speeds she will turn in a circle twice her length.

The engine is fully muffled and is mounted in airplane style giving free cargo space below. The propeller is protected by a steel guard and heavy screen which allows her to lay up to a dock or other boats, safely. The sail-like air rudder has a steadying effect in connection with the water rudder when running up to a landing, preventing the bow from falling off with the wind.

The hull is of mahogany throughout, highly polished on the decks and sides and painted with navy bronze on the bottom. The frames, stem and keel are of selected white oak. Both bottom and side planking are sealed with oak battens screwed in place.

Two passengers are accommodated in the driver's seat and three on the wider seat, directly behind. The steering gear, instrument board, windshield, electric self-starting device, et cetera, are all of the automobile type. The instruments include a Delco ignition and lighting system, tachometer and water temperature indicator. The dials of the last two are carried under a glass panel.

A 40-gallon gasoline tank is located amidships. It supplies fuel for approximately five hours, running at 30 miles per hour.

AT HIGH SPEED

The water rudder has automatically been drawn up and the boat is being steered by the air rudder in the same way as an airplane. The steering resistance is thus lowered

The Great Earth-Moon Catastrophe

By Albert G. Ingalls

WILL the much-debated Wegener hypothesis survive or must it be discarded?

This intriguing new theory of an Austrian geologist explains the earth's past geologic history more simply than any other. Difficulties that geologists have got around only by elaborate interpretations, and some which cannot otherwise be explained, vanish in the light of the hypothesis that the continents are not stationary but are slowly drifting. Yet, according to many scientists, there are fatal objections to it.

The Wegener hypothesis of continental drift was summarized by the writer last January, in the Scientific American. It is completely explained in Wegener's book, "The Origin of Continents and Oceans." Briefly, Wegener believes that the several existing continents are the scattered parts of a former super-continent. Fifty-odd millions of years ago some stupendous world event broke this greater continent into several parts. These pieces of rock —the present continents—floating in the denser, heavier rock below, gradually drifted apart. Some of them are supposed to be moving yet. North America, for example, is believed to be slowly drifting westward.

An Event that Convulsed the Earth

Wegener says the whole hypothesis of continental drift occurred to him, when he was studying a map of the world. This was in 1910. He was impressed with the congruity of both sides of the Atlantic coasts. It would be worth while, before reading further, to get a map of the world, or better still, a globe, and study it in this light. Pickering's map, reproduced in the central illustration on this page, provides similar food for thought. The two Americas have a peculiarly curved coastline, yet, curiously enough, that of Europe and Africa fits it like a jig-saw puzzle. Wegener thought this was more than a coincidence. He still believes the two land areas were once one.

When Professor Wegener first propounded his hypothesis, it was frequently characterized as "simply another attractive theory." This characterization may turn out to be correct. Today, however, and especially within the past year or two, the world's geologists, geophysicists and other scientists are treating it more seriously, although few of them accept it yet. This is a good beginning. Discussion, argument, controversy—these beget familiarity. Familiarity often leads to acceptance. P. T. Barnum, who understood the philosophy of getting publicity before the first publicity agent took his first job, said, "I don't care what they say about me as long as they keep on talking about me." As evidenced by the special journals of the scientific societies, the Wegener hypothesis has now reached the stage where scientists are talking about it.

The most essential part of any theory that may be advanced to account for an event should be a statement of the *cause* of that event, yet Wegener is vague or silent concerning the original cause of the supposed break-up of the one-time super-continent. He simply assumes that it took place. It has remained for an astronomer, Professor William H. Pickering, Director of the Observatory at Mandeville, Jamaica, B. W. I., and Professor Emeritus of Astronomy at Harvard University, to supply a theory of the break-up. Singularly, Pickering supplied this theory three years *before* Wegener conceived his own hypothesis.

During or before 1907, Pickering had been struck, as Wegener was afterwards, by the "jig-saw puzzle" congruity of the margins of the continents bordering the Atlantic Ocean. He drew a map to illustrate it and published that map, with an article presenting his theory of the break-up of the original land mass of the earth, in the *Journal of Geology*. The cause of the break-up, Pickering believed (and still believes, according to replies to inquiries directed to him) was the birth of the moon from the earth, some 1200 million years ago. In its astronomical aspects, this theory of the origin of the moon is accepted by most astronomers.

"Assuming a hot, solid, ellipsoidal earth," says Pickering, "with an interior more or less liquid, at least beneath the equator, revolving on its axis once in about four or five hours, we have a picture of our as yet moonless planet as conceived by the astronomer." At this time, a planetoid, passing comparatively near to our rapidly revolving earth, set up the necessary gravitational force which wrenched away three-quarters of the earth's crust. For millions of years, this material surrounded the earth in the form of a ring like that of Saturn. Later, this ring coalesced to form the moon.

When the catastrophe that gave birth to the moon took place, a scar of some sort would have been left on the earth, and Pickering sets out to see if he can find that scar.

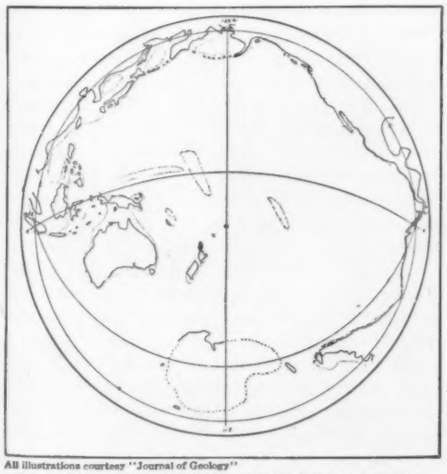
The outer crust of the earth is lighter, less dense, than the inner parts on which, according to the accepted theory of isostasy, it floats. The density of the moon, which is known, corresponds closely to that of the earth's outer thirty-six miles. Was the moon once part of the earth's outer crust?

Professor Pickering's map of the earth's oceanic hemisphere, shown in the left-hand column, supplies a strong suggestion in that direction. "The volume of the moon is equivalent," he says, "to a solid whose surface is equal to that of all our terrestrial oceans, and whose depth is thirty-six miles." The inference is plain. When three-quarters of the earth's outer layer was torn away from the earth, the remainder of the crust may have been broken in two. Having been summarily split by this stupendous event, the continents, floating in the denser, heavier rock below them, then drifted apart like ice flows.

We Barely Missed Being Fish

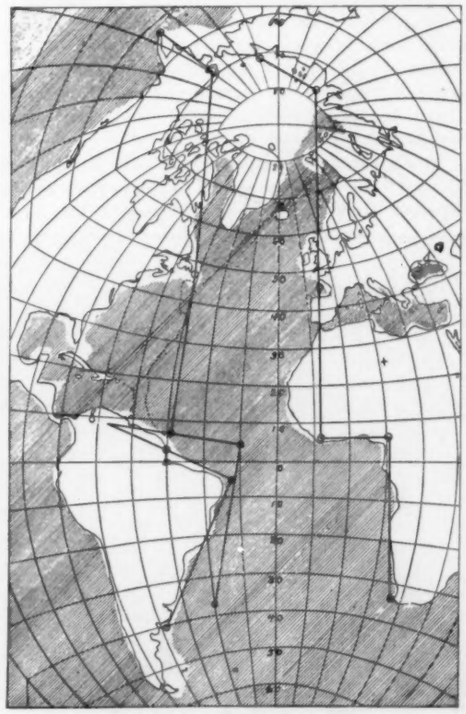
To the moon, Professor Pickering points out, we humans owe our very existence. Have you ever seen the moon through a telescope? To the naked eye, it is a dull, flat, uninteresting disk, but when magnified by a small telescope, it is an exquisite bubble of silver, silently and lightly floating in space—a former fragment of the earth's body which will, according to astronomical theory, return to us millions of years hence.

"If it is true," writes Prof. Pickering, "that we owe our continents to the moon, then the human race owes far more to that body than we have ever before placed to its credit. If the moon had not been formed, or if it had carried away the whole of the terrestrial crust, our earth would have been completely enveloped by its oceans, as is presumably the case with Venus at present, and our race could hardly have advanced much beyond the intelligence of the present deep-sea fish."



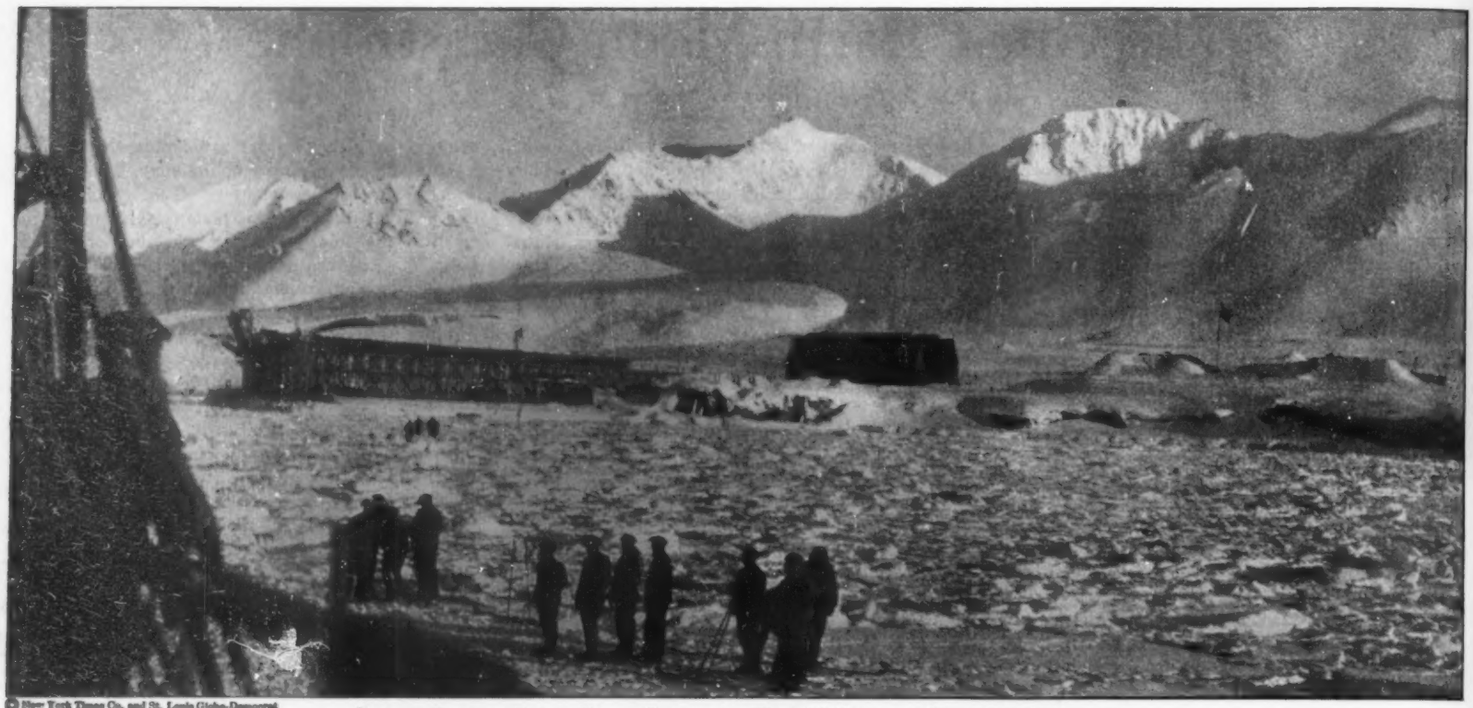
All illustrations courtesy "Journal of Geology"

WAS THE MOON BORN FROM THE PACIFIC?
The oceanic crust areas match the moon in volume



HOW THE CONTINENTS SPLIT ASUNDER
Pickering's map shows how they fit one another

THE LAND AND WATER HEMISPHERES
When the moon departed the remaining crust broke up



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LOOKING OVER THE FROZEN HARBOR TOWARD THE "NORGE'S" HANGAR AT KINGS BAY, SPITZBERGEN

Radio and the "Black" Sun

Invisible Waves Penetrate the Arctic Glow to Tell of Explorers' Historic Triumphs

By Orrin E. Dunlap, Jr.

WHEN the Eskimos become snow-blind from the reflection of the midnight sun on the ice, Old Sol looks black instead of like a pale glowing disk and the natives of the north call it the "black light." The radio men who accompanied the aviator-explorers into the polar regions discovered that the "black" sun absorbs energy from the Hertzian waves just as the light of ordinary sunrise, mid-day and sunset reduces the range of etherial communication. Therefore, they relied to a great extent upon the short wavelengths, projected high into the upper atmosphere to cut through the gloaming of the north with historic messages destined for civilization.

New York to Pole in 32 Days

It was on March 1, 1909, that Admiral Robert E. Peary and a party of seven other men from the United States, together with seventeen Eskimos, 133 dogs and 19 sledges started from Cape Columbia on a hike across the ice sheets and glacier fringes which formed a 423 mile barrier to the prize of three centuries and Peary's dream and goal of twenty years—the north pole. Thirty-seven days later, on April 6, 1909, Peary and Matt Henson, a colored follower, stood on the top of the earth. One hundred and fifty-three days elapsed before Peary reached the northernmost telegraph station at Indian Harbor, Labrador, from where he announced, "I have the pole."

In sharp contrast with this, seventeen years later, Commander Richard E. Byrd of the United States Navy and his American pilot Floyd G. Bennett, hopped off from Kings Bay, Spitzbergen, in a Fokker three-engine plane, the *Josephine Ford*, on May 9, 1926, at 12:50 A.M., Greenwich time. At 4:20 P.M. of the same day they returned to their base, having circled the pole and made the dash back in 15 hours and 51 minutes. The round trip measured 1,360 miles.

Dispatches were soon vibrating the ether between the transmitter at Spitzbergen and the receiver at Loeddington, Norway, connected by land wires with the powerful transatlantic station LCM, Stavanger, Norway, whence the news was broadcast to America. Little time elapsed before radiophone stations throughout the country were interrupting their programs of Sunday evening entertainment to announce: "Byrd flew across the north pole and returned to Spitzbergen. The trip was successful."

Byrd's expedition, said to have been one of the best equipped that ever set out to conquer the arctic, departed from New York City aboard the *S. S. Chantier*, April 7, 1926. Thirty-two days later the plane flew over the polar scenery and verified Peary's observations, that an expanse of broken ice stretching as far as the eye could reach in every direction surrounded the top of the world, and that no life, not even a bird, polar bear or seal was seen. It was merely a matter of minutes for radio reporting to spread this news around the world.

© Pathe News

THE HOP FROM KINGS BAY

Commander Byrd and Pilot Bennett leaving for the north pole in their three-engine Fokker plane

In contrast to this, Peary's trip from the time he set sail from New York City aboard the polar ship *Roosevelt*, on July 6, 1908 took 429 days. He carried no wireless equipment and was out of touch with civilization during his sojourn in the ice fields.

Short Waves Overcome Absorption Effect

Byrd's plane carried a radio transmitter designed by Malcolm P. Hanson of the United States Naval Research Laboratory, consisting of a single 50-watt, crystal-controlled transmitter developing about 30 watts in the aerial. It was tuned to operate on the 44 and 61-meter wavelengths. The airplane receiver was a short-wave, three-tube circuit built to pick up the signals from the base ship *Chantier*. The flyers did not attempt to use the radio during their dash to the pole because they were too busy using their bubble sextant, sun compass and three magnetic compasses as well as navigating the plane.

While the Fokker was in the air, the operators on board the *Chantier* maintained a constant watch tuned-in on the 44-meter wave so that they would be ready to intercept messages in case the plane was forced to land. At other times, the operators listened, during American night hours, for signals from amateur stations. According to Malcolm P. Hanson, who crossed the Atlantic on the *Chantier* to install and test the equipment, it was found that the 20-meter waves were most efficient as a means of overcoming the absorbing effect of the light rays.

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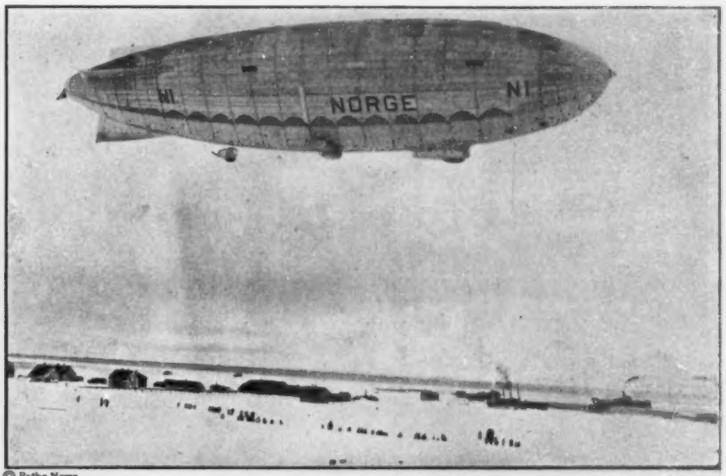
MAIN STREET, KINGS BAY

The village from which both Byrd and Amundsen started for the north pole



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OFF FOR THE POLE

The vertical radio aerial is suspended from the bow of the polar airship

He reported that the 40-meter waves were received with good intensity but that they were erratic and less dependable than the 20-meter signals. On one occasion the operators of the *Chantier* talked with an amateur in New Zealand and with another in Brazil. The Brazilian impulses were so loud that the operators thought the station was in France, the shores of which were only a few hundred miles distant. The 32.79-meter waves of station 2XAF, Schenectady, New York, were heard with good intensity. They faded only slightly when the *Chantier* was 400 miles west of Scotland and at Kings Bay.

"Norge" Sends First Message from Pole

Mr. Hanson explained that the well modulated 500-cycle note of NKF, the Naval Research Laboratory at Anacostia, District of Columbia, was best read as long as it could be received by a non-oscillating, regenerative circuit. The amateur transmitters which were heard best, had as a rule, a raw 60-cycle note, which broadened the tuning to such a degree that the rolling of the ship did not affect audibility. He said that the amateurs in the New England states were surprisingly predominant.

Two days after Byrd's visit to the pole, the Amundsen-Ellsworth-Nobile expedition cast off from Kings Bay in the Italian built dirigible *Norge* bound for Alaska via the north pole. Soon after the big ship was floating over the ice fields, Captain Birger Gottwaldt, wireless expert of the expedition, dropped the 300-foot aerial wire through an insulator in the deck of the cabin, with a sinker on the end to keep the wire taut. Immediately radio began to furnish a running story of the flight and shortly after 1 A.M., Greenwich time, on May 12, 1926, the first message ever received from the north pole reached the operators at Spitzbergen. It read, "We reached the north pole at 1 A.M. today and lowered flags for Amundsen, Ellsworth and Nobile."

The next message was radiated at 3:30 A.M., when the 200-watt transmitter flashed: "Lowering three flags, Norwegian, American and Italian, when the *Norge* was over the north pole, was the greatest of all events of this flight. Riiser-Larsen's observations showed that we were over the pole. The *Norge* descended and speed was reduced, when the flags were lowered over the wastes whose edges gleamed like gold in the pale sunlight, breaking through the fog which surrounded us. Roald Amundsen first lowered the Norwegian flag. Then Ellsworth, the Stars and Stripes; finally Nobile, the Italian flag."

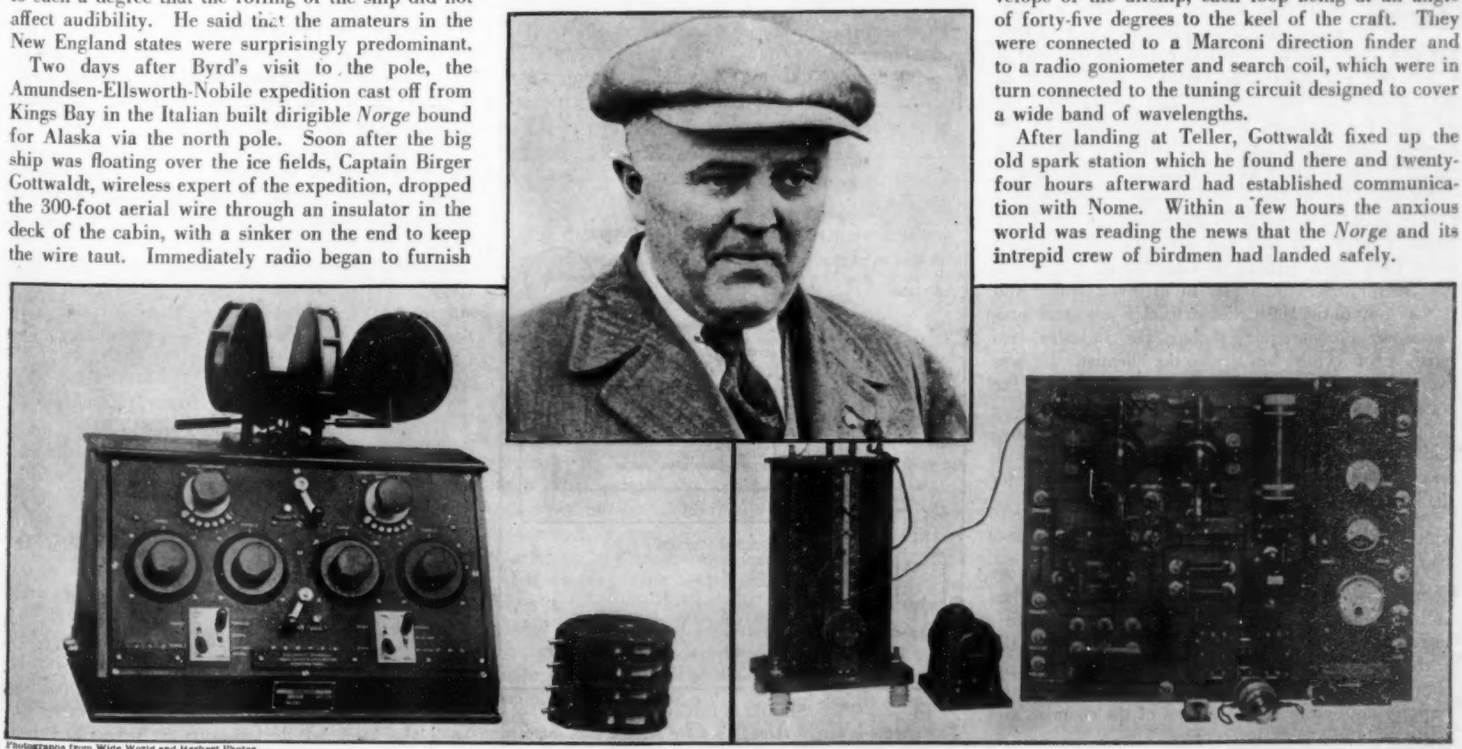
The *Norge* then proceeded to fly over the "Unknown Continent," between Alaska and the pole which man had never explored. After a 3,291 mile cruise of seventy-one hours the dirigible came to earth on May 13 at 8 P.M., Alaska time, at Teller, Alaska, ninety-one miles west of Nome.

After the *Norge* passed the pole, great difficulty was encountered in operating the radio apparatus because ice coated the aerial wire and the windmill driver of the generator, which supplied the electrical energy to operate the transmitter and charge the storage batteries. Efforts were made to establish communication with Alaskan stations but with no success. Then when the airship sailed over Alaska the heavily iced aerial bumped along the ground when the craft descended to a low height to ascertain her position. Ten hours before landing at Teller, Gottwaldt picked up two different Alaskan stations and took bearings on them by means of the direction finder. These proved to be of great assistance.

Amundsen Lands Safely at Teller

The direction finder consisted of two double loops placed at right angles to each other outside the envelope of the airship, each loop being at an angle of forty-five degrees to the keel of the craft. They were connected to a Marconi direction finder and to a radio goniometer and search coil, which were in turn connected to the tuning circuit designed to cover a wide band of wavelengths.

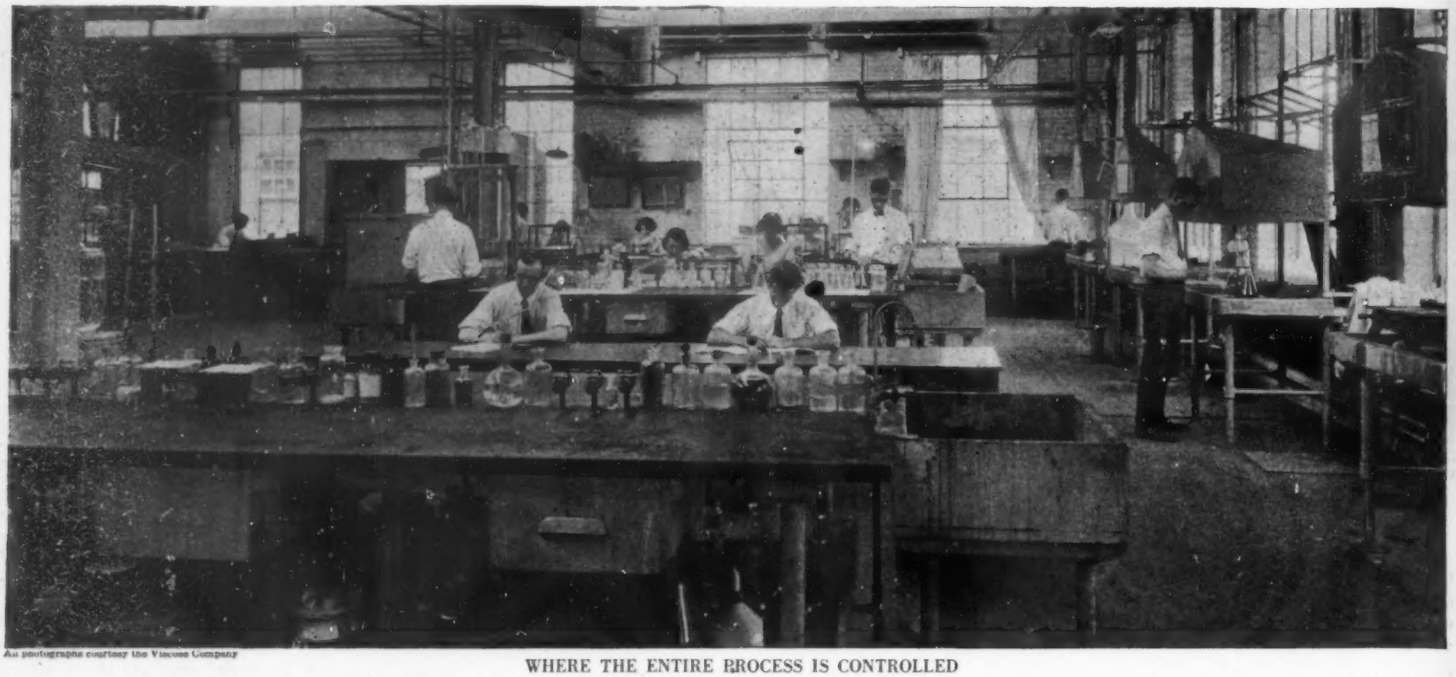
After landing at Teller, Gottwaldt fixed up the old spark station which he found there and twenty-four hours afterward had established communication with Nome. Within a few hours the anxious world was reading the news that the *Norge* and its intrepid crew of birdmen had landed safely.



Photographs from Wide World and Herbert Photos

THE RADIO OPERATOR AND EQUIPMENT OF THE *NORGE*

LEFT: *The receiving set with its three sets of coils covering 300 to 25,000 meters.* INSERT: *Captain Birger Gottwaldt, radio operator.* RIGHT: *The simplified radio transmitter*



All photographs courtesy the Viscose Company

WHERE THE ENTIRE PROCESS IS CONTROLLED

Each step must be analyzed constantly in the chemical laboratory lest the strands vary in thickness, grow harsh or weak or turn out to be something that is not rayon at all and that is entirely unsatisfactory for commercial use. The chemist is, then, the guiding light of the entire industry and is responsible for the finished product

The Latest Member of Our Textile Family

Rayon, Although Commercially Unknown Thirty-five Years Ago, Has Come Into General Use Today

By N. A. Parkinson

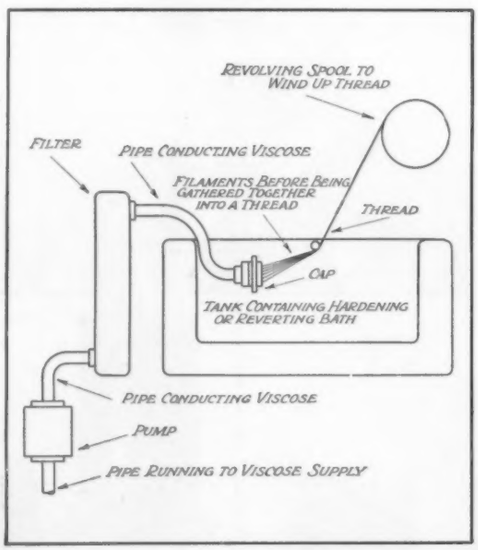
THE chemist is fast becoming master in his own house. Everywhere about us are manifestations of the part he has played in making this world a safer, saner, and better place in which to live. Yet how many pause to consider that the chemist is a very real and dominating factor in contributing to our modern-day conveniences and comforts? Let us take, for example, but one achievement of the chemist—the manufacture of artificial silk, now called rayon, in which he has triumphed over Nature.

Although the imitation of silk was suggested by a French scientist as early as the middle of the Eighteenth Century, it was not actually accomplished until 1884 when Hilaire de Chardonnet patented a process for the manufacture of artificial silk. And it was not until 1891 that artificial silk was produced on a commercial scale. The industry languished for awhile, but not so the chemist. He was ever on the alert, always hunting and searching for some way, either chemical or mechanical, to improve his product, and now, after thirty-five years of painstaking research, his efforts have been crowned with success and the world's output of rayon is greater than that of natural silk.

Machine-Made Cocoons

For a long time this man-made silk suffered by being known under the misnomer, artificial silk, thus following in the footsteps of cotton which was first introduced to the world as a species of wool. But within the last few years the French name, rayon, signifying ray—something light and bright—was happily applied to this invention of the chemist, and has now been generally accepted.

Rayon has found a place of its own in the industrial world, not because of its resemblance to nature's product, but because of its own peculiar characteristics which have made possible many applications of it in the textile industry. What is this substance and how is it made? It is the effort of the chemist to produce the same kind of silk fiber as that made by the silkworm and it is accomplished by using as its foundation part of the same substance that the silkworm eats, that is, cellulose extracted from a vegetable source. The manufacture of rayon requires chemical and engineering skill of a high degree. A delicate and extremely accurate control of all the processes through which it must pass is absolutely essential.



SPOOL SPINNING

The viscose is forced through a plate pierced with fourteen or more minute holes and immersed in an acid bath that hardens it immediately. The thread is then wound on a spool and is soon ready for use in the loom

There are four different commercial processes for the manufacture of rayon, all using as a basis chemically purified cellulose, whether obtained from wood or cotton, but more than three-fourths of the world's output is made by the viscose process.

The manufacture of rayon may be likened to the silkworm spinning its cocoon. Just as the silkworm ejects from its mouth a viscous substance which hardens immediately upon contact with the air, so likewise do mechanical spinners, after subjecting the cellulose to various chemical treatments, finally send forth very fine streams of viscose, which harden into silk threads of any desired length, thus differing from those of the silkworm whose threads average five hundred yards in length.

Rayon Fibers More Uniform Than Silk

The fiber of the silkworm is never uniform, while that made by man is of equal diameter and strength throughout its structure. This is because the silkworm does not move with the mechanical precision and regularity of man-made spinners, nor does it eject the viscose substance from its mouth in the constant stream, with the unvarying force and at the unchanging rate of speed that is possible when mechanical regulators are employed.

When the solution goes from the chemical plant to be spun into fiber and thrown and reeled into its various forms, its chemical characteristics determine its strength, quality and appearance. If there has been the slightest deviation from prescribed procedure in any of the operations through which it has passed, the solution may be rendered impotent for

THE RAW MATERIAL ARRIVES

Spruce wood or cotton has been treated to remove the gums and resins and arrives in the form of sheets

later manufacture into fiber, yarn, finished textile, and so forth. The finished product is soft and flexible, and is noted for its fine luster, uniformity and adaptability to dyeing processes.

The first step in the manufacture of rayon is that of cooking the raw stock, spruce wood or cotton, by the aid of live steam, in a large boiler or digester. With the assistance of chemicals, this cooking removes resin, gums and other foreign matter from the natural cellulose. After leaving the digester, the mass is bleached to bring it to a proper degree of whiteness.

At this stage, the cellulose consists of tiny fibers which are now run through a series of rollers to squeeze out the water. These rollers compress the fibers into sheets, each of which is about the thickness and consistency of blotting paper. The general procedure in preparing the cellulose sheets is similar to that used in pulp and paper making.

From Cellulose to Rayon

The large sheets are now cut to twelve-inch squares and are soaked in a solution of caustic soda for about twenty-two hours. Hydraulic presses then force out the excess liquid. The sheets are cut into small particles by revolving knives and kept in especially constructed containers at an even temperature for about forty-eight hours. This is called the mercerizing process.

The product, now called alkali-cellulose, is placed in a revolving churn together with a certain predetermined amount of carbon bisulphite. The mixture is revolved slowly for two to three hours, forming cellulose xanthate. This is a plastic substance, light orange in color, and it can be dissolved readily in water.

PREPARING TO MERCERIZE

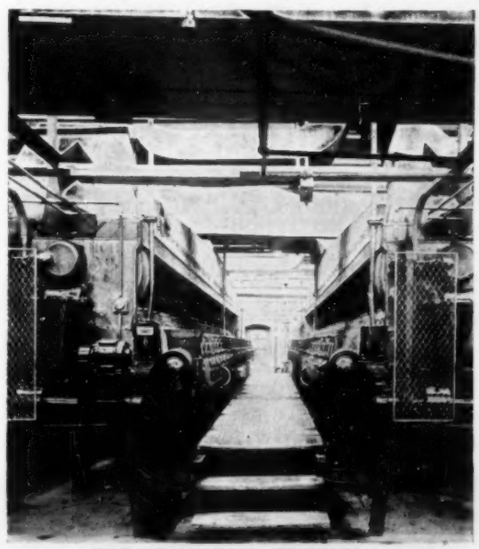
The large sheets are cut into twelve-inch squares and soaked in a caustic soda solution for 22 hours

The cellulose xanthate, with a weak solution of caustic soda, is placed in a machine with rapidly revolving blades which beat it thoroughly and mix it into a uniform mass. This mixing operation is the final process in converting the cellulose to the liquid called viscose. Viscose, derived from the word "viscous," resembles molasses in color and consistency.

Before the viscose can be spun into threads, it must be aged by standing in large vats or tanks at an even temperature. Before leaving the aging cellars for the spinning room, it must be filtered carefully to remove all dirt or foreign matter which may have accumulated.

Now comes the spinning of the viscose into threads, the first real evidence that fabric is to be produced. The secret of forming the filaments of thread is that the viscose solution is a strong alkali that hardens upon coming in contact with acid.

Simply stated, the mechanical part of the operation consists of forcing the viscose through a plate containing fourteen or more holes which is immersed in an acid bath. Upon leaving the plate, the streams of viscose immediately harden into long thin strands before they have time to run together again. The holes in the plate, through which the liquid is passed, are from two to five one-thousandths of an inch in diameter, invisible to the naked eye unless held before a strong light.



THE MECHANICAL SILKWORMS

These are the machines in which the viscose is formed into filaments that are then twisted into thread form

A revolving spool gathers the filaments together and winds them into thread. There are two methods of doing this—spool winding and box spinning. In the first method, the filaments are grouped together to make up a thread which is immediately wound on a spool, rotated at a regulated number of revolutions per minute. The thread is wound in parallel filaments in a semi-gelatinous state, requiring further hardening by chemical treatment, followed by a thorough washing after which it is finally dried. The filaments, although delicate, form a substantial thread when grouped and slightly twisted together. The twisting operation consists of unwinding the filaments from the first spool and by the aid of a rapidly revolving spindle, putting in the desired twist while winding on another spool. It is then reeled from the second spool into the form of skeins.

In the box spinning method, the separate twisting operation is eliminated. Upon leaving the perforated plate, the filament passes over a revolving wheel and drops through a glass funnel into a revolving box. A twist is put into the strands between the pulley and the lower end of the funnel. The box is revolving and the centrifugal force throws the thread to the sides of the box and causes it to form a coil in the shape of a short, hollow cylinder about an inch across, the outside diameter corresponding to the inside measurements of the box. This package of thread is then to be wound into skeins, the standard rayon skein being 44 inches in circumference.

REELING INTO SKEINS

The standard rayon skein is 44 inches in circumference. Washing and drying is done when rayon is in skein form

After a final washing and drying, the cellulose is back in the original pure, dry state in which it entered the first or mercerizing step of conversion, only instead of being in the shape of a sheet, it is in the form of a brilliant, lustrous thread, called rayon.

Rayon is, then, a vegetable fiber, analogous in composition to cellulose, whereas the fiber of the silkworm is of animal origin and contains nitrogen. Its strength, when dry, however, is only about half that of natural silk of the same size. When wet, it loses a large part of its strength, and it is because of this that care should be exercised when laundering rayon fabrics. Water of any degree of temperature may be used without fear that the garments will turn yellow. Soaps or compounds appropriate for silks or woolens are suitable, and starch may be used, as with cotton goods.

Has a Marked Affinity for Dyes

Rayon always retains its luster, and if it is carefully handled while wet it will regain its original strength when dry. Its filaments are continuous and smooth. Hence, there are no fibers to rough up as on worsted, linen, and cotton materials.

At one time it was feared that the rapid growth of this young industry might result in an oversaturated market. Apparently there is nothing to fear in this regard. Its steadfastness of color, its luster, and its affinity for dyes have multiplied its uses and usefulness. It has worked wonders in the knitting business. By merely combining a few strands of rayon with wool, a beautiful luster was imparted to the material. Almost overnight the demand was greater than the supply.

The union of rayon with other textiles has supplied some of our most attractive fabrics. Take, for example, the cross-dyed silk patterns, where the

SORTING AND GRADING

The material is graded according to detected defects

vegetable fiber of rayon takes one dye while the animal fiber of silk takes another, producing an attractive fabric. This is also true of wool, the rayon usually manifesting itself in stripes or plaids. Cotton and rayon take the same dyes, cotton forming the base and rayon furnishing the lustrous surface.

The hosiery industry uses the greatest percentage of rayon at the present time, with the cotton industry as a close second. It is also used extensively in underwear, laces, linings, sport goods, umbrellas, raincoats, shoe coverings, ribbons, gloves, millinery braids, trimmings, and in many other fabrics. Its use in underwear is finding wider application since it has been demonstrated that it absorbs moisture from the body and at the same time permits the evaporation of the excess moisture. Formerly the impression was quite prevalent that rayon was inflammable, but this has been disproved.

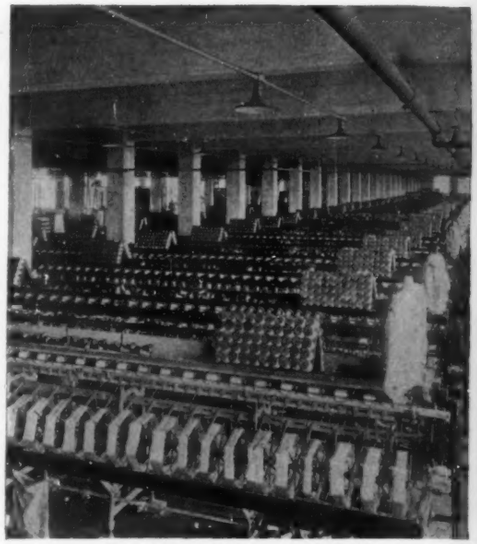
Rayon has revolutionized the world's textile market. The industry is now well established in France, the place of its birth, where it was practically boycotted by other branches of the textile industry until 1923. The knitting industry then increased its consumption until domestic production in 1924 was three-fifths greater than that of 1923 and imports of rayon yarn were considerably more than doubled. There are now more than fifty plants producing rayon in France, and yet consumption has increased to such an extent that although in 1925 France ranked fifth in world production, with an output of nearly fourteen and one-half million pounds, it was inadequate to meet domestic requirements.

Textile manufacturers have not only bowed to the inevitable and accepted rayon, but are manifesting great enthusiasm in combining it with other fibers. It is one of the important textile industries in England. Recently the biggest English producer started a branch in Canada, where the abundance of wood seems to indicate that we may look for large-scale production. In Germany, the old munition works have formed the nucleus of the industry, which is now reported to be in a better condition than her other textile industries.

China and Japan Using Rayon

The output of Belgium has been absorbed at home, and Switzerland is gradually finding more extensive use for rayon. The development of the artificial silk industry in Italy has been phenomenal. The Italian product is not of the highest quality, but much of this is overlooked because of its market selling price. The claim has been advanced that Italy is seeking world conquest of the rayon market. Statistics show that in 1925 she occupied second place in world production. The South American countries, while not producers, are large consumers of rayon. Even the Far East is following the example of the rest of the world and is turning to artificial silk.

China, the home of the natural silk industry, affords a growing market for rayon, as does India, and rayon is making rapid progress in its invasion of Japan. America, because of the superior quality of the product her chemists produce, is able to compete with cheaper foreign labor, and leads the world in consumption as well as in production. In 1925 about one-third of the rayon produced in the world came from the United States, or nearly 55 million pounds.

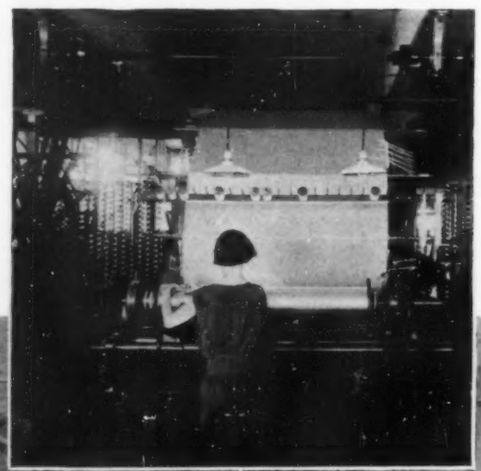


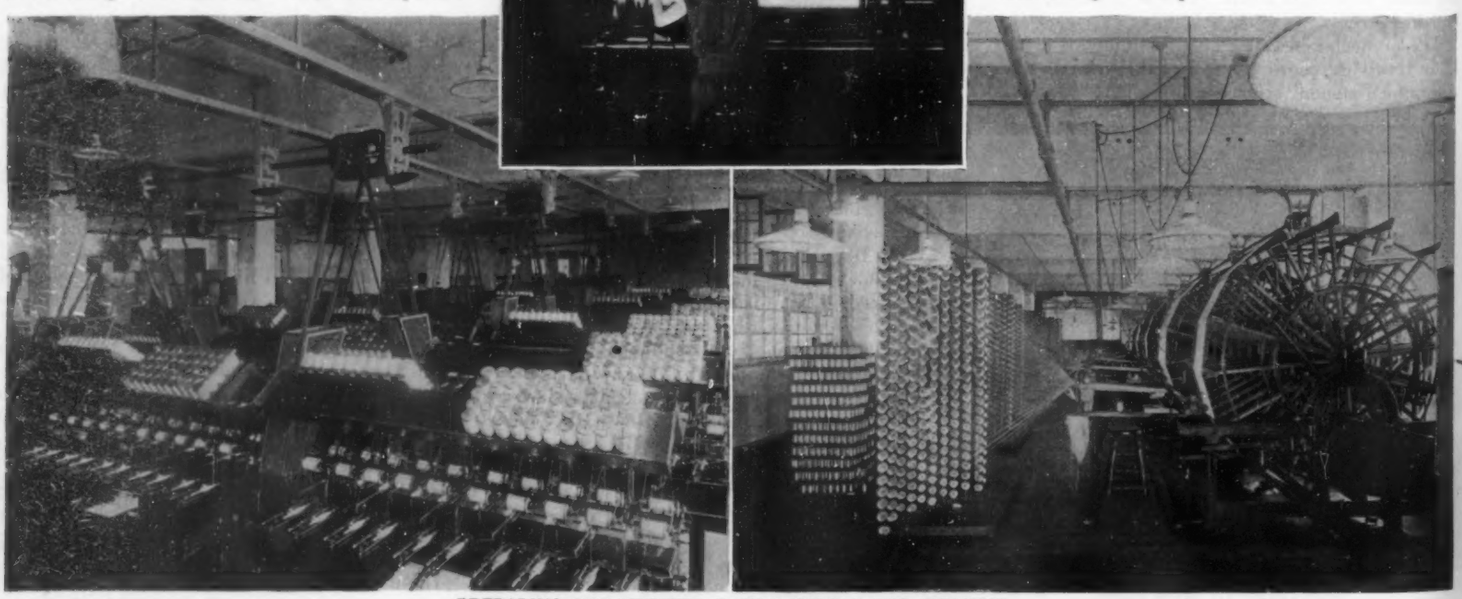
THE SPOOLING DEPARTMENT

Here the rayon is wound from the skein reels to spools

In the end, probably the whole question narrows down to price. Its low price, as compared with that of natural silk, has given it an unquestioned place in world markets. Unlike most other textiles, its price has been stable both during and since the World War. It is made from cellulose, which is the chief constituent of all plant life, so no matter what ills may befall its sister industries, rayon will always have an inexhaustible source of raw material upon which to draw. Its price should always be as nearly stable as it is possible to make any price, and not subject to market fluctuations and the like.

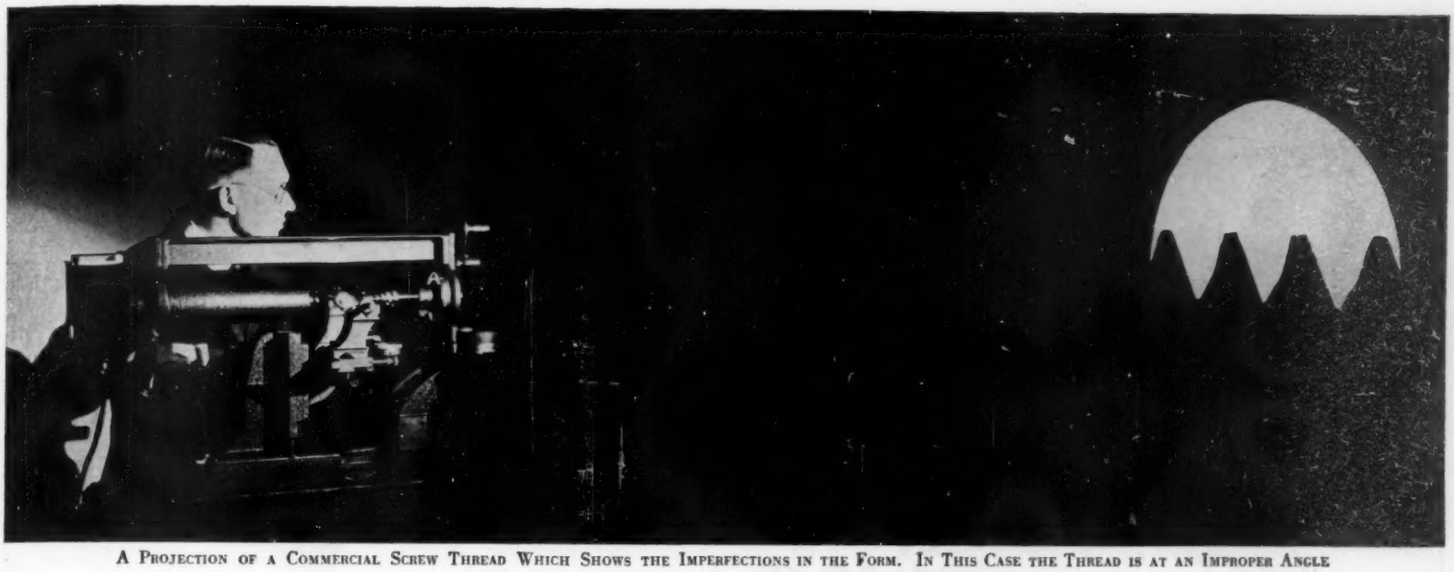
When rayon is mixed with other fibers, its presence should be made known to the purchaser. It is not a competitor of silk, linen, wool or cotton. Instead, it is being adopted by these other textile industries as an integral part of their products and is establishing a firm place for itself.





PREPARING THE FINISHED RAYON THREAD FOR WEAVING

LEFT: *The rayon threads are transferred from the spools to the weft form for the weaving loom.* RIGHT: *Other spools of thread are rewound on the creels or drums which are to furnish the warp.* INSERT: *From the creel, the warp thread is drawn on the loom beam which then is placed on the loom and the weaving started*



A PROJECTION OF A COMMERCIAL SCREW THREAD WHICH SHOWS THE IMPERFECTIONS IN THE FORM. IN THIS CASE THE THREAD IS AT AN IMPROPER ANGLE

Scientific Accuracy a Commercial Necessity

The Contour-Measuring Projector Aids Inspection of the Finished Product

THE demand for greater and greater accuracy in manufacturing has brought into existence within recent years many machines of remarkable precision for quantity production of interchangeable mechanical parts, to meet the demand for closer and closer tolerances and more exacting material requirements.

Precise parts, made to a close limit of accuracy, assure proper functioning, maximum strength and wear—in short, highest value and lowest ultimate cost—of the completed products.

The adoption of accurate machines in modern manufacturing processes is one of the most significant developments of modern industry. The investment in machines for the production of standardized mechanical parts, and in facilities for rigorous inspections, proves the importance of making the various mechanical parts to very close limits of accuracy throughout the manufacturing processes.

The successful use of machines for quantity production of interchangeable parts depends upon correspondingly accurate tools for making these parts, and upon efficient means of measuring and inspecting both the tools themselves and the finished work.

The contour-measuring projector throws a highly magnified image of the profile of the part under investigation by optical projection on a chart or screen.

An error of only a thousandth of an inch appears a quarter of an inch in size under a magnification of 250 diameters; and an error of one ten-thousandth is readily discernible.

The scope of the work to which this instrument is adapted is very wide. New uses are being found almost daily and it has proved its value in such work as tool cutting, gear making, screw-thread cutting, and in making automobiles, electrical goods, phonographs, sewing machines—in fact, in the making of a long line of manufactured articles, from clocks and watches to engines and pipe fittings.

What the Apparatus Is

The projector is both a microscope and a projection apparatus of the highest quality, combined in a sturdy, efficient device for machine shop and factory. It is accurate enough for the most exacting laboratory tests, and yet simple enough to be used by any competent workman without special training.

Briefly described, it consists of a highly perfected optical system and suitable mechanical parts to protect and support the optical system, to hold the work in proper position, and to provide all necessary adjustments, and means for making accurate measurements.

The lamp-house, condensers, compound microscope, and right-angle prism are all in fixed relation to each other, so that at all times the entire optical system is centered about one single axis, and the screen receiving the image is always perpendicular to this axis.

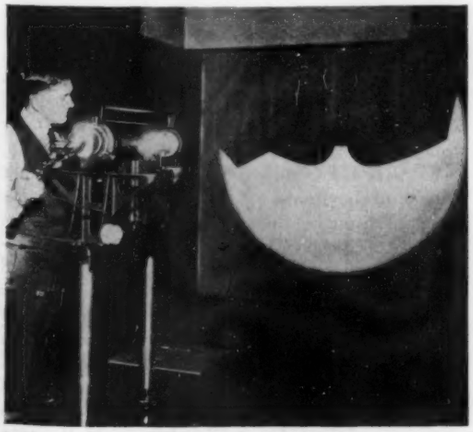
When used as a thread projector, the entire optical system is turned to an angle equal to the mean helix angle of the screw. This method of screw-thread projection has a number of very marked advantages over the other possible method of projecting the image of a screw-thread, with the axis of the screw perpendicular to the axis of the optical system.

The centered optical system as used gives images which are the best of which lenses are capable, whereas in an uncentered system, which would be necessary if the axis of the screw were at right angles to the light beam, the image would be formed by oblique pencils of light passing diagonally through the objective. This would result in a decidedly inferior image. When this optical system is turned through the mean helix angle, the outline of the image differs in shape from the contour of the thread by a very small, but definite, known amount, for which the correction can be easily applied. With the centered optical system, there is no loss of time in looking for the angle of best illumination as is necessary with the uncentered system.

The work holder consists of two strong supports with adjustable "V" blocks and accurate centers with bushings and clamps. Work placed between these centers, or on the "V" blocks can be moved in three directions by means of the compound slide, up and down, and sideways, to bring it accurately into the path of the light, and backward and forward to focus the image of the work on the table or screen.

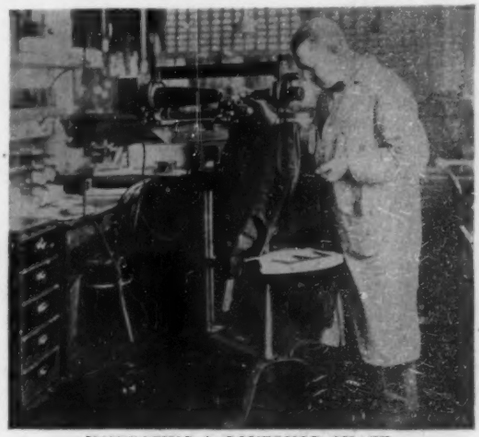
The centers will accommodate a wide range of work, such as screws, hobs, cutters and gages. If the work is too large and heavy to be held between the centers, these may be removed, and the work may be placed directly on the "V" blocks.

The demand for scientific accuracy is coincident with any considerations of cost reduction and therefore vital to every manufacturer.



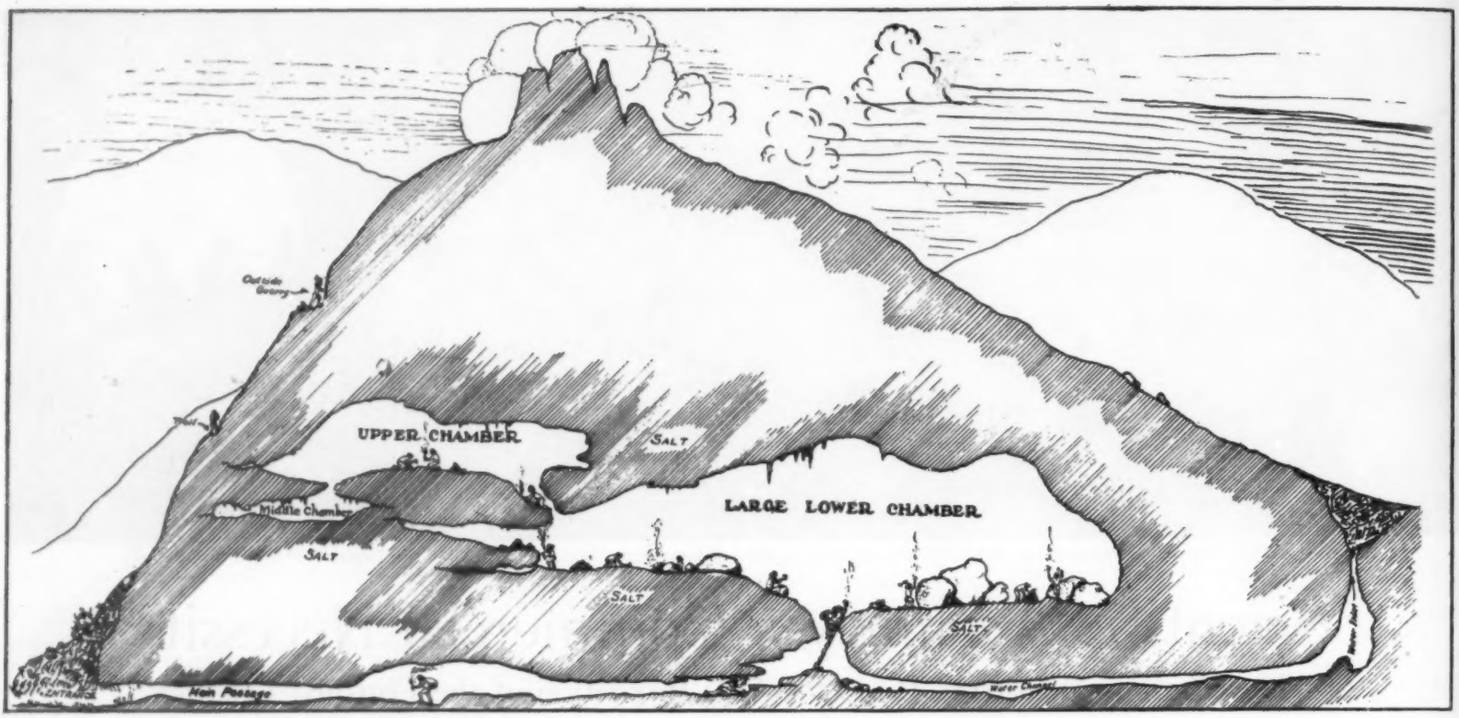
IN A CAN FACTORY

Extremely accurate inspection of the sealing rolls is necessary. Here we see the projector in use



INSPECTING A GOVERNOR SHAFT

An error of 1/1,000 of an inch appears to be ¼ of an inch under a magnification of 250 diameters



A CROSS-SECTION OF A SALT HILL SIX MILES SOUTH OF ST. THOMAS, NEVADA

Ancient Salt Mines of the Indians

In Nevada a Cave with Peculiar Markings Made by Man Has Turned Out to Be a Salt Mine of the Indians of Two Thousand Years Ago

By M. R. Harrington

Archeologist in charge of the Nevada Expedition of the Museum of the American Indian, Heye Foundation

THAT mines were operating in Nevada many centuries before the days of Aurora and Pioche—of Virginia City, Tonopah and Goldfield, is one of the interesting discoveries made by archeologists now delving in the ruins of Pueblo Grande de Nevada, popularly known as the "Lost City," in the southern part of that state. "Many centuries" is putting it mildly, for the finds show that mining was in progress about the beginning of the Christian Era, some twenty centuries ago, and there are indications which point to work at an even earlier period.

A Mystery to Be Solved

It was a salt mine, or rather, a series of salt mines, that has just been explored by the expedition sent out by the Museum of the American Indian, Heye Foundation, of New York City, working in cooperation with the State of Nevada. The principal mine is situated in a peak of solid rock-salt owned by the Virgin River Salt Company, about four miles south of St. Thomas, Clark County, Nevada, and some six miles from the expedition headquarters at the Lost City.

The entrance to the principal cavern proved to be through a low, tortuous underground passage, a natural drainage channel which may be followed completely through the mountain. But we left it about a hundred yards from daylight, clambering up out of it into a series of vaulted chambers, hot, dark and silent, and smelling strongly of bats.

Turning our lights upon the walls, we were astonished to find them covered with markings, apparently made by the hand of man—curious circles and ovals, a foot or so across, outlined by grooves cut into the salt. Some were separate, some overlapping, and some strung together like links in a chain, and all were especially numerous wherever the salt outcrops seemed purest. What could they be? Were they ceremonial symbols of some sort? Certainly they were utterly unlike any of the several types of ancient rock-writings or petroglyphs we knew to be characteristic of the district.

We looked about us for evidence bearing on the problem and observed that the floor of the chamber where we stood was covered with a dry, dusty deposit. Surely, if human hands had carved the circles, a great many hours must have been spent in the work, and the carvers must have left some traces of their visit in the loose deposit underfoot—traces that an archeologist might interpret, and from which he might hope to learn the identity of the carvers, even, perhaps, the purpose of the carvings. So we applied for, and obtained, permission to investigate the caverns.

A PEAK OF ROCK SALT

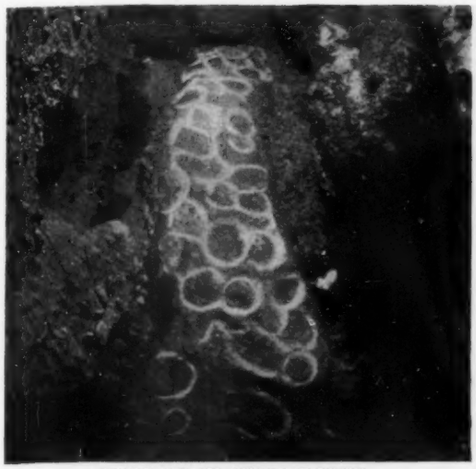
Below the towering battlements can be seen the opening to one of the large salt mine tunnels

The Mystery Is Solved

The systematic digging had not proceeded far, when it dawned upon us that the place was nothing more nor less than an ancient salt mine, and that the deposit was merely a mass of salt mine refuse, consisting mainly of discarded salt, ranging from large chunks down to dust, and profusely perfumed with bat droppings and somewhat mixed with other things.

We were led to this conclusion first of all by the finding of hundreds of stone picks and hammers scattered throughout the mass which surely were not there by accident. The picks were waterworn boulders six or eight inches long, with one end chipped to a point. They had evidently been held in the hand. Some of the hammers had been held in the hand also, but most of them were provided with notches or with rude grooves for the attachment of wooden handles; while a few, to our astonishment and delight, still retained their wooden handles in perfect condition, due to the dryness of the cave plus the preservative action of the salt.

We finally learned the significance of the myster-



WALL OF AN ANCIENT MINE

Note the circles made by the prehistoric salt miners

ious circles which had puzzled us at first, when we reached the original bottom of the cavern, a ledge of solid rock-salt, and carefully laid it bare. It was covered with just such circles and ovals as those we had seen on the walls, but with every little mark and detail beautifully preserved by the dust and refuse that had covered them.

When we examined these carefully, we found that the circles had been carved into the salt with the stone picks, grooved around and around, deeper and deeper, until a raised circular block of salt was left in the center. Then this block had been broken out with the stone hammer to be taken home by the miner. We were able to prove this by fragments of just such salt blocks, found in the mine refuse, which showed parts of the encircling groove with the marks of the stone pick still plainly visible.

After the excavation was finished, and we had laid out and classified all the specimens we had found in the cave, we discovered that nearly everything we had found had to do with salt mining, directly or indirectly.

First of all there were the stone picks and hammers already described, actually used in getting out the salt. Then there were numerous fragments of wooden hammer handles, and quantities of strings, made of yucca fiber and of Indian hemp, which had served as wrappings for the handles, and to bind together brush torches. There were many sticks from the torches themselves, burned at the ends; also torches made of shredded bark, all used to furnish light for the miners at their work; while larger burned sticks and beds of ashes suggested that fires had sometimes been built on the cave floor for this purpose.

Various digging sticks, bearing the marks of long use, had probably been employed to dig away the refuse accumulated over the outcrops of salt to be mined. One neatly made little brush of fiber doubtless served to sweep out the grooves as the work went on.

So much for the tools of the ancient miners. Other relics had to do with their clothing. Most interesting of these were the sandals—thick, with pointed toes, neatly woven of yucca fiber and showing the wear of long use. One was complete, even to the strings. There were strands from fur-cloth and feather-cloth blankets, and a little hank of native cotton strings—likely part of a girdle—dyed a rich red. There were also several bits of yarn spun from soft animal hair of some kind, and a number of strings and pieces of flat braid made of black human hair.

Still other articles yielded by the cave deposit told us of food—of the lunches our prehistoric laboring men took with them to work. Most abundant of these were the corn-cobs—evidently the remains of "roasting-ears" cooked on the spot. These seem to indicate that several distinct varieties of this thoroughly American plant were grown.

Pottery Determines Age of Mines

We even found a receptacle that had doubtless served to bring someone's lunch into the mine—a netting bag, made from cords neatly twisted from the soft fiber of the Indian hemp, which still grows in the neighborhood. Sometimes, however, the miners must have brought in their lunches in pottery bowls instead of bags, for pieces of several such food dishes were discovered. Water was carried in pottery canteens also, but gourd bottles seem to have been even more popular, if we may trust the number of fragments we found of both.

The question naturally arises—how do we know the age of these workings—how can we tell that the mine was in operation about the dawn of the Christian Era? The pottery tells the story, for the gray ware with patterns in black, dug from the debris of the cave, is identical with that found at Pueblo Grande de Nevada—the Lost City—a few miles away, and was undoubtedly made by the same people. Thus we know that the ancient salt mine was operated by the people of the Lost City, or of one of the related settlements belonging to the same period.

The Lost City seems to have been at its height about the end of the Pre-Pueblo Period and the beginning of the Early Pueblo Period, roughly estimated at two thousand years ago. That the earliest salt workings may be even older may be guessed from the discovery of a fragment of a typical, carved club of the Basket-Maker Period, probably antedating the Lost City by another thousand years or so.

ONE OF THE MINE ENTRANCES

This once was the outlet of an underground water-course

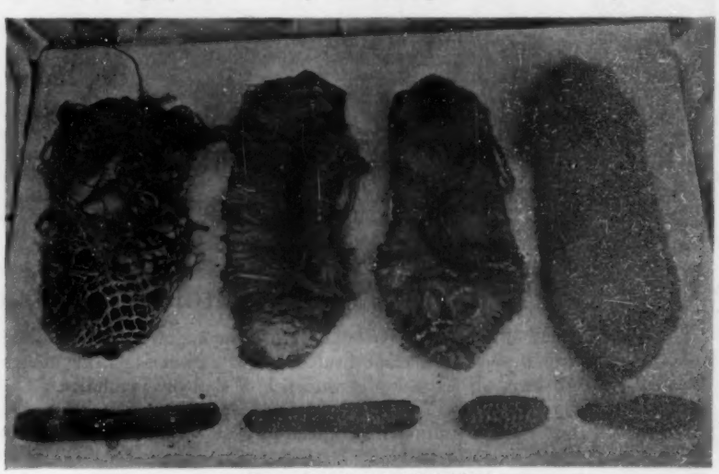
One question remains unsolved: Why did the ancient people choose to work in a dark cavern, when there were various outcrops of salt in broad daylight? We can not explain it on the ground that these open-air outcrops now visible were covered at that time, because stone hammers identical with those found in the cave are numerous about them. The outside salt ledges were mined, too.

The only possible explanations which seem to fit the case are: first, that the ancient people may have believed that salt derived from deep in the bosom of Mother Earth was more healthful as food and more efficacious as medicine than the same mineral found on the surface; or second, that each of the Indian settlements of the period owned property rights in the salt, each community having its own particular claim; and that the outside workings were taken up by the first comers on the scene, leaving to bands arriving later only the privilege of mining beneath the surface.

This latter explanation fits in very well with the customs observed until recently at the Sacred Salt Lake near the present Indian pueblo of Zuñi, New Mexico. Here the area suitable for gathering salt has been divided up and allotted to different groups of Indians from time immemorial. This, then, may very well be the solution to the problem of the underground mining of salt.

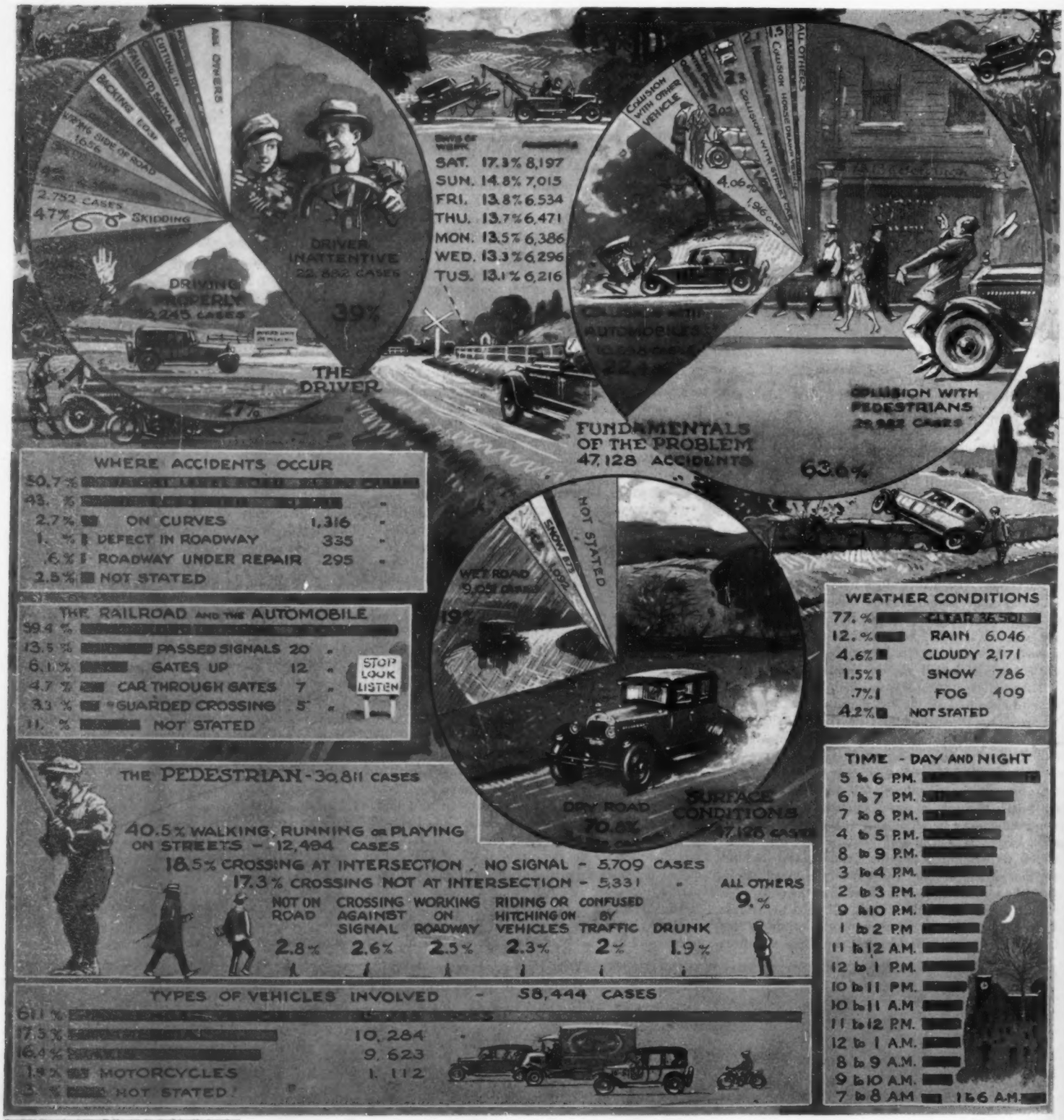
ANCIENT MINING TOOLS

Here are shown several specimens of stone hammers used by the miners of ancient Nevada for work in the salt mines. The original wooden handles and wrappings are intact



MINERS' PERSONAL PROPERTY

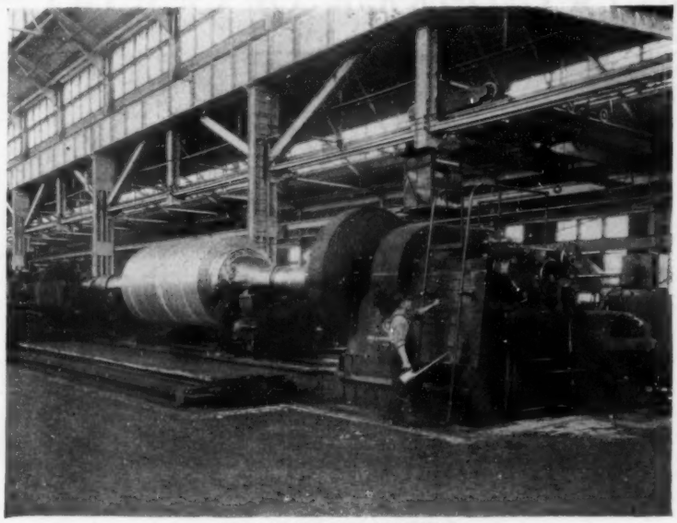
At the left is shown a net bag which was probably used for carrying food. Sandals are shown to the right and several corn-cobs are at the bottom of the illustration



Specially drawn by Arthur T. Merrick for the Scientific American

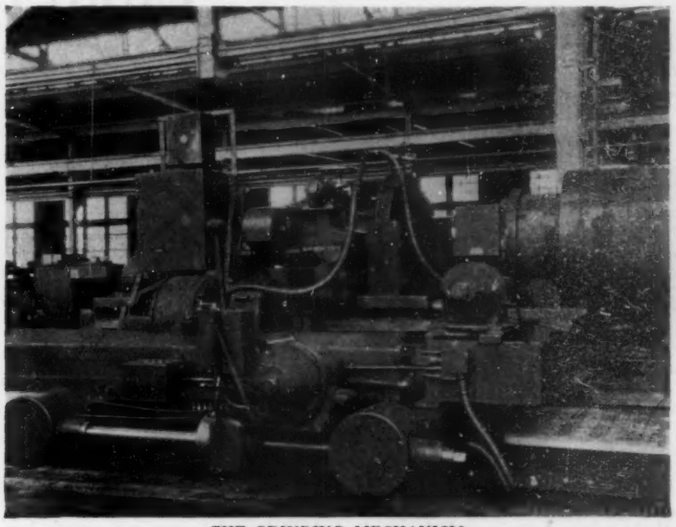
The Automobile Accident Problem Analyzed

Without figures to guide us, we should say that the majority of automobile accidents ought to happen on a curve in a wet road and at night, but things are not what they seem when the deadly yardstick of statistics is applied. The statistics of accidents in New York State put forth and illustrated above were compiled with great care by an efficient Bureau of Motor Vehicles. This gives an admirable cross-section to analyze. The comparisons speak for themselves. There were 47,128 automobile accidents in New York State in 1925 in which 1,981 persons were killed and 54,398 injured. The totals change when we come to certain types of accidents. Thus, pedestrians figured in only 30,811 cases, while 58,444 vehicles were involved. Perhaps the most surprising fact is that railroad crossing accidents numbered only 148 with 75 deaths. To eliminate all the grade crossings in the United States would cost twenty billion dollars, or more than the estimated value of railroad properties. When people talk about grade crossing accidents, they should look at the figures first and count the cost. If everyone would cease jay walking, if children would keep off the roadways and streets, if young men would pet in parlors and drivers would obey the Eighteenth Amendment, a large percentage of our automobile accidents could be avoided and the appalling figures of deaths reduced.



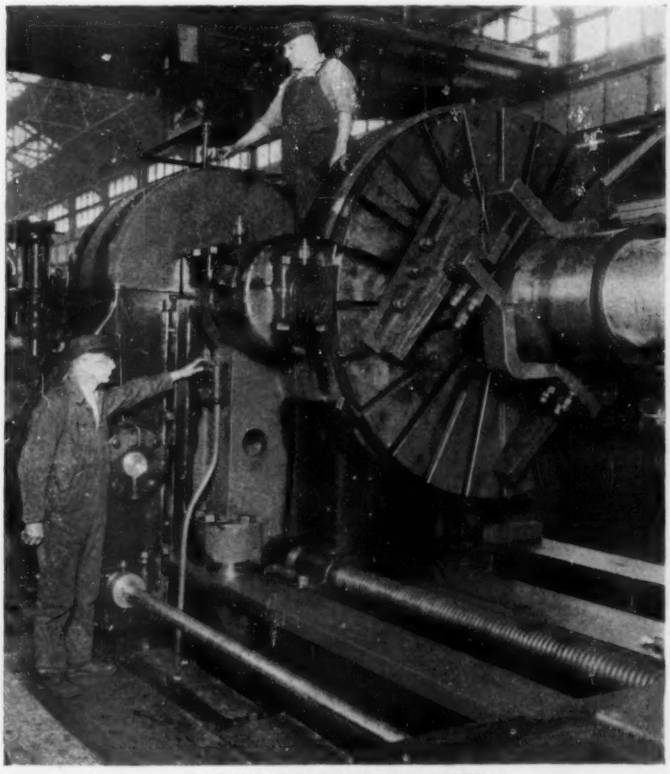
THE COMPLETE MACHINE

This combined lathe and grinder is entirely operated by motors and is controlled by push-buttons which are interlocked to assure safety



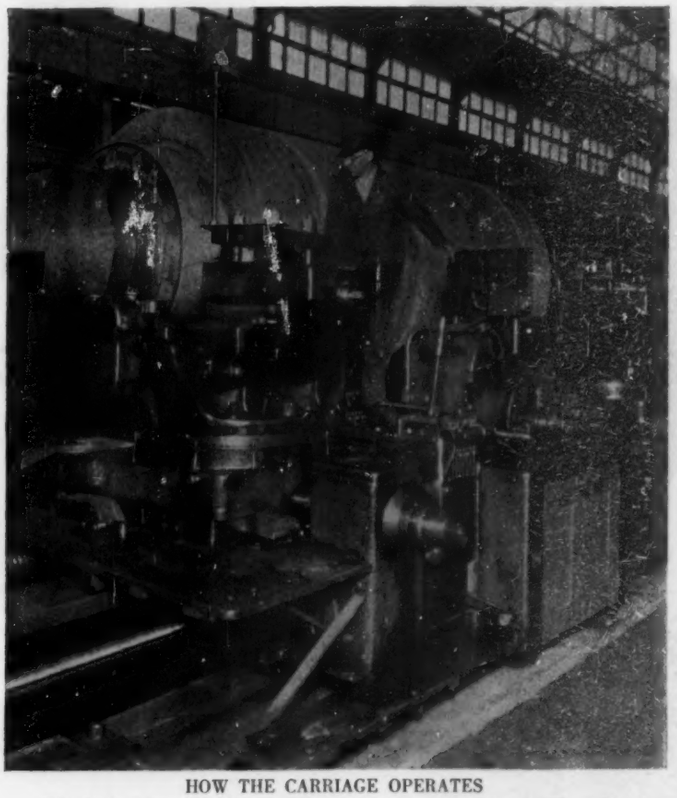
THE GRINDING MECHANISM

This complete grinder is entirely self contained and has individual safety push-button control. It has an extremely long grinding range



SHOWING THE LATHE'S CAPACITY

The 113-inch swing of this lathe is clearly shown above. Compare the size of the men in the photograph with that of the huge mechanism



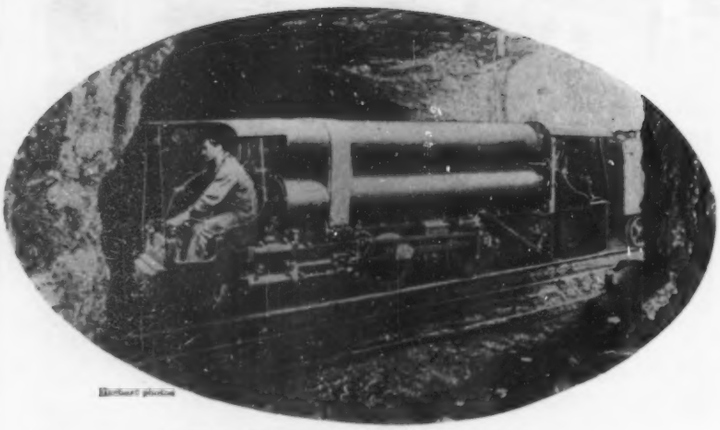
HOW THE CARRIAGE OPERATES

The feed and traverse of this carriage are also motor driven. All cutting operations can be controlled from the switchboard shown

A Monster that Answers a Finger's Touch

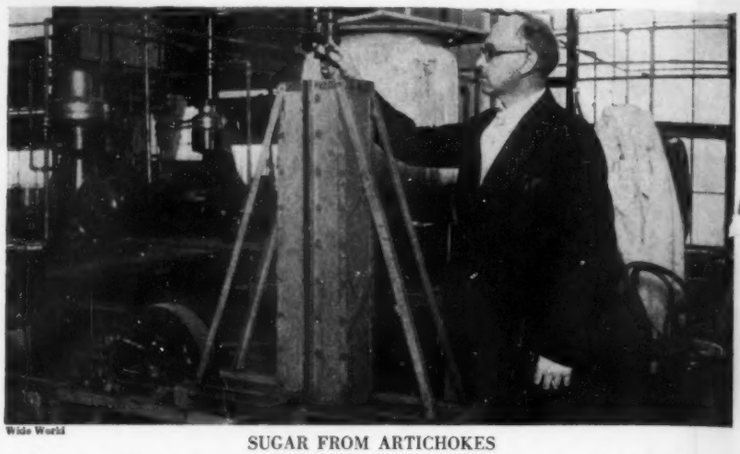
The vast proportions to which present machine shop practice has developed, is well illustrated in the combined engine lathe and grinder which is installed in the General Electric Company's Schenectady plant. This huge machine has a clearance of 45 feet between face plate and tailstock, with a swing of 113 inches over the bed and 94 inches over the carriages. It will support a working load of 300,000 pounds. On one side of the bed are two tool carriages, each with motor-driven feed and traverse, and on the other side is a complete Landis grinder mounting a 36-inch grinding wheel. Eight motors totalling 139 horsepower are used for the controls; all are of the 230-volt, shunt-wound type. The main drive motor is of 75 horsepower; the two carriage motors are of 10 horsepower each and the grinding wheel motor is of 25 horsepower. The others range down to one horsepower. A number of trolleys suspended in a pit beneath the bed provide power and control circuits for the traveling members, namely the carriages and grinder bed. Push-button interlocking control is installed on both carriages, on the grinder and at the headstock. Each of these main controls has a "safe" button which can be set to prevent the motor from being started at any station until it is released again at the station where it was originally set. The magnetic controllers are therefore interlocked so that in case a tool should gouge in, full field will be applied to the carriage motors, thus slowing them down, while a limit switch prevents the operation of the carriage motors against the traverse.

From the Scrap-book of Science—Ca



A COMPOUND COMPRESSED AIR ENGINE

A modern type of mine mule—the compressed air locomotive. Within the past few years most of the mining operations which were formerly performed by man and animals have been done by power. The locomotive shown employs a triple-expansion air engine



Wide World

SUGAR FROM ARTICHOKES

In the future when you sweeten your coffee, you may use artichoke sugar or levulose, the sweetest of all sugars. This illustration shows the slicing machine devised by the Bureau of Standards for cutting up the tubers of the artichokes after which they are converted into sugar

Wide World

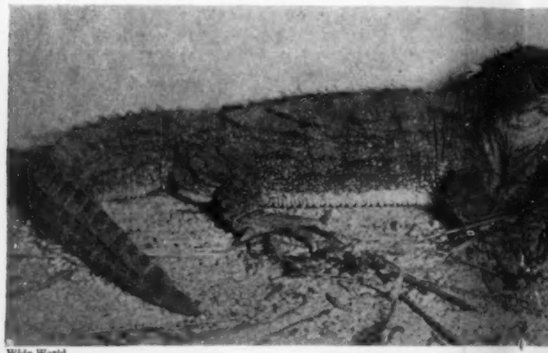
AN UNDERWATER TORCH

A torch such as this is being used for cutting open the hull of the submarine S-51, which sank last year. The flame is protected from water by a jet of compressed air

Pacific & Atlantic

DAMPNESS CAUSES MARBLE TO STREAK

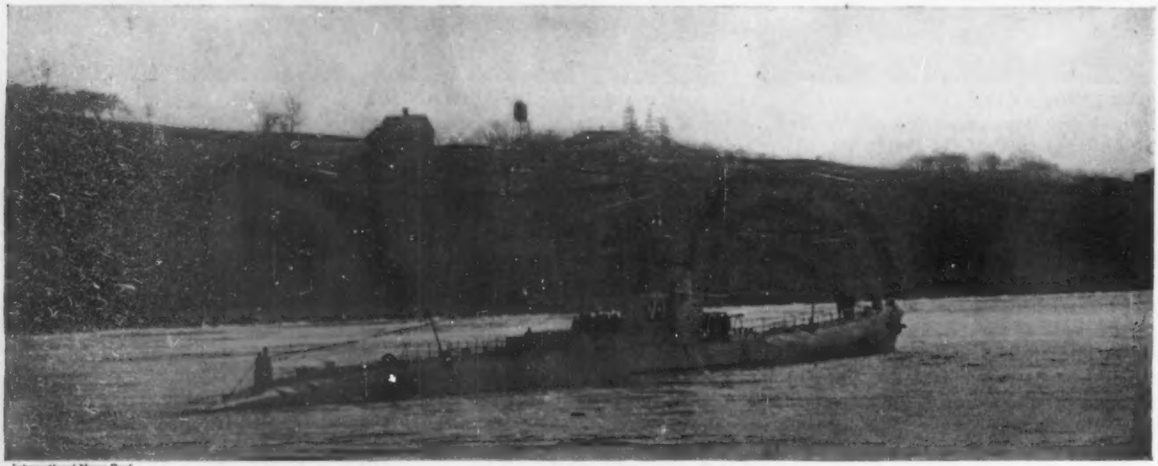
D. W. Kessler of the Bureau of Standards who has been selected to find the reason why marble on some buildings has been streaking. Four miniature marble rooms are used



Wide World

THE ONLY REPTILE IN

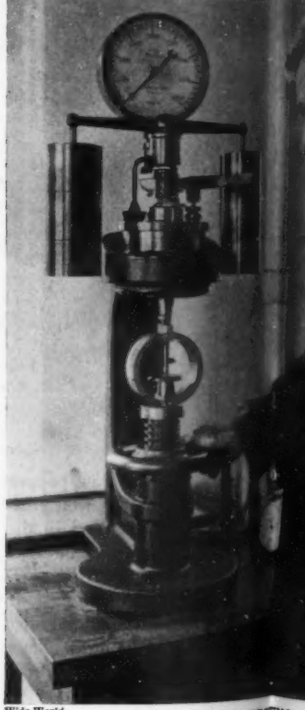
Sphenodon, called locally the tuatara, is the o group of reptiles that otherwise became extinct millions of years ago. Neither were there islands until man brought them the



International News Reel

THE *V-1* COMPLETES HER FIRST TRIAL TRIP

The largest submarine in the United States Navy starting out on its first trial trip. The giant undersea craft successfully negotiated a 204-foot dive and navigated for a full day in the vicinity of Block Island, to the complete satisfaction of the commanding officer and of the crew aboard



Wide World

GOVERNMENT TESTING

Captain S. N. Pretenko of the Bureau of Stan a metal ring which measures a load up to

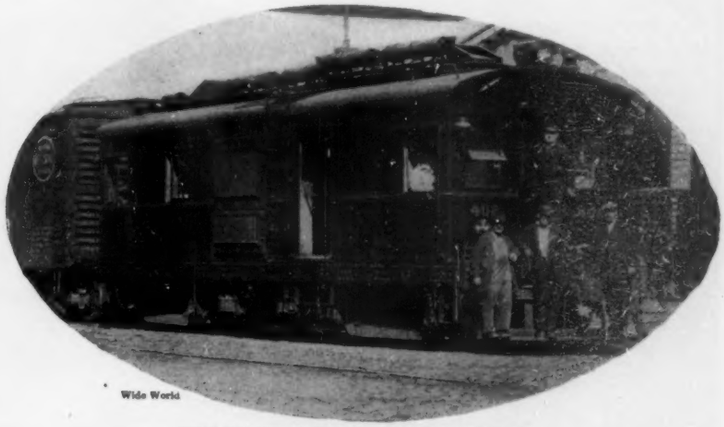
—Camera Shots of Scientific Happenings

the sweet-
of Stand-
o sugar

Acme

A MILE A MINUTE

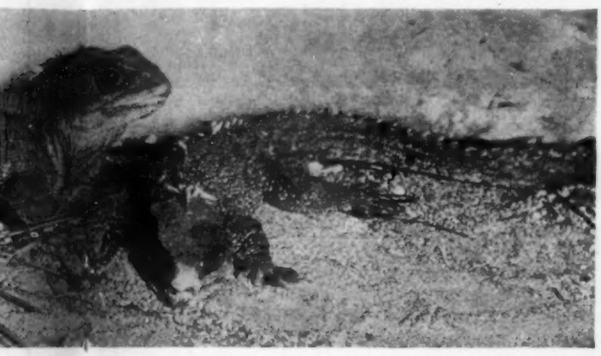
This new means of water transportation, a gliding ship, recently made its appearance on the Danube River. The boat is equipped with two airplane propellers which are used in the same manner as on an airplane. The ship traveled from Pressburg to Vienna in forty minutes



Wide World

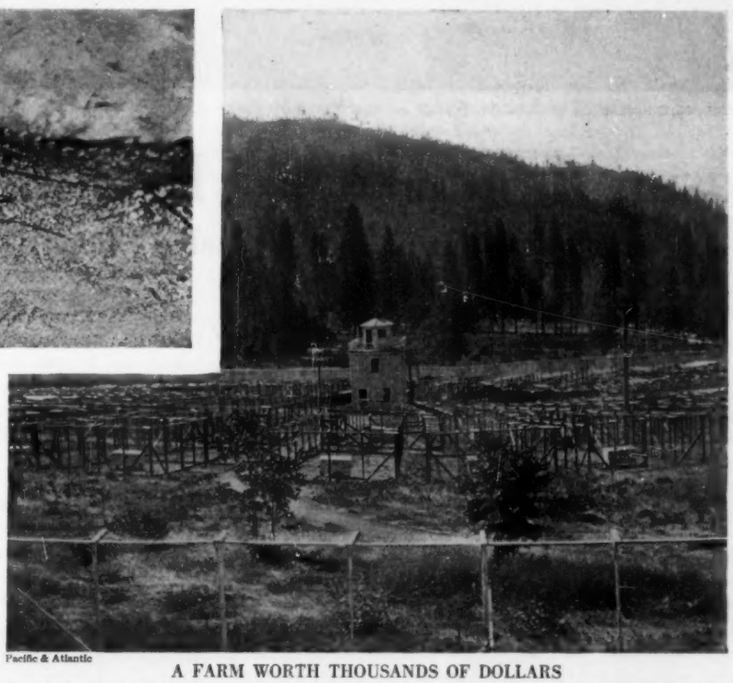
NEW DIESEL-ELECTRIC SWITCH ENGINE

In switch-yard work, where service is markedly intermittent, the Diesel locomotive is at its best. Between tasks its engines can be stopped and the fuel upkeep reduced to nothing, while the steam locomotive in service consumes fuel whether working or idle



LY REPTILE IN NEW ZEALAND

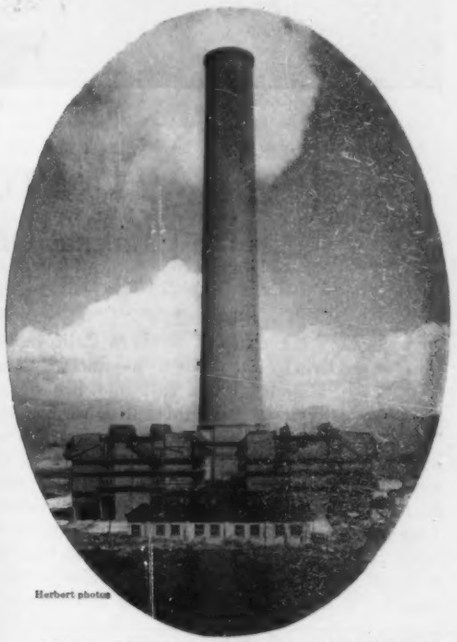
he tuatara, is the only living representative of a large vise became extinct when the great dinosaurs died out, vither were there any mammals in these interesting brought them there comparatively recently



Pacific & Atlantic

A FARM WORTH THOUSANDS OF DOLLARS

Quantities of silver foxes are now being raised annually in California. One of the principal farms is located at the base of Mt. Shasta. This region is excellent for the work



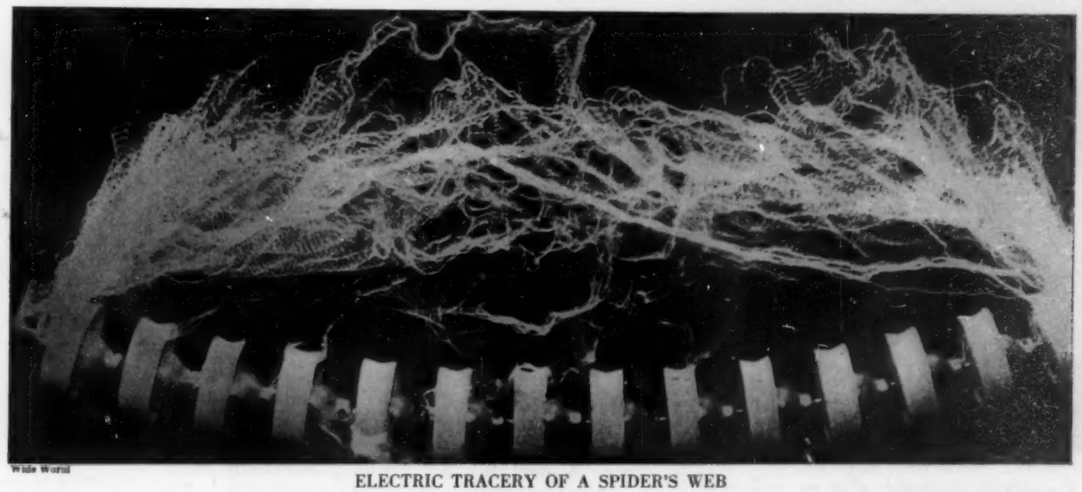
Herbert photos

COULD HOUSE WASHINGTON MONUMENT

The largest brick chimney in the world is that of the Anaconda Copper Mine at Anaconda, Montana. From the base to the top rim the huge cylinder measures 585 feet

NMENT TESTING APPARATUS

of the Bureau of Standards operating his invention, measures a load up to a maximum of three tons



Wide World

ELECTRIC TRACERY OF A SPIDER'S WEB

Testing a chain of fourteen insulators at the laboratories of the General Electric Company. Under electric pressures of more than a million volts the sparks jump gaps several feet in length. Insulators that must function at 330,000 volts are tested at higher voltages

THE COSMOPOLITAN HARBOR OF AVALON, HAVEN OF ALL KINDS OF PLEASURE CRAFT

A Treasure Island in the Pacific

Santa Catalina, Off the Coast of California, Is a Veritable Island of Silver

By Herbert O. Warren

OFF the coast of southern California lie what are known as the "Channel Islands" which fall into two groups. First we have those that are comparatively simple in topography, and second those of a rugged nature which are even now more or less an enigma to the geologist. We rarely hear of more than one of them—Santa Catalina Island—about eighteen miles straight out to sea from San Pedro. It is interesting from the pronounced variation of form over the ordinary coastal island. It is twenty-one miles, or thereabouts, in length and the width varies from three to seven miles, except in one place where there is a narrow isthmus which is of so low an altitude that Nature seems to have started to make two islands instead of one, but failed to complete the job.

BAGS OF TREASURE

Part of a valuable shipment of silver ore destined for the smelter at Shelby, California. A shipment is valued at approximately 150,000 dollars

Rugged mountain chains run through the island with spurs extending down to the coast, separated by deep canyons with precipitous sides which have their outlet in the sea. Some of the peaks are over two thousand feet high. There is little or no arable land and it would be difficult to find two hundred acres of tillable land in any spot on the island. The shores are pounded by the heavy surf of the Pacific. The island was once inhabited by Indians, but owing to its ruggedness and the scarcity of water, it proved habitable only in a few places.

Originally an Unsuccessful Venture

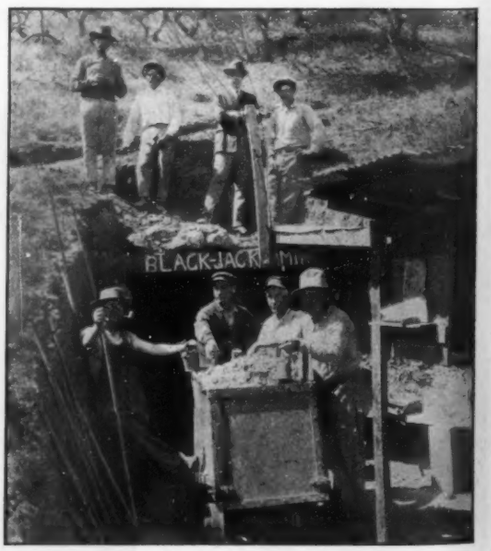
An English syndicate at one time bought the island for its mineral possibilities and tried to exploit them. However, they were unsuccessful and in desperation they were glad to have the man, from whom they had purchased Catalina, take the island back again.

William Wrigley, Jr., Chicago capitalist, bought the island seven years ago for three million dollars and began spending a large sum every year in developing Catalina into a resort—and incidentally looking the island over a bit closer than did the Spanish explorers who, with their pirate ships many years ago, used to haunt the caves of Catalina while searching for places to secrete their ill-gotten loot.

The new owner spent thousands of dollars building many miles of road into the interior fastnesses of the island, developing water power and making various other improvements. He rode on horse-back over it, day after day, covering practically every foot and examining rock and ledge formations. Today, after having carefully checked assayer's reports from mining prospects at various points of the island, he is convinced that it is composed very largely of silver ore. Catalina comprises some 55,000 acres, and is in the shape of a great ship.

There are 20 veins being worked at Catalina, scattered from the extreme southwest end at Johnson's Landing—where Bouchet, a Frenchman, drifted a tunnel and built wooden rails and dump carts nearly half a century ago—to Seal Rocks, at the extreme northeastern portion where Catalina's famous seals flop around on rocks of silver.

At the Isthmus, a tunnel has been drifted into the



BRINGING OUT THE ORE

A carload of silver ore assaying up to 347 dollars per ton that has just been brought to the surface from one of the shafts of the Black Jack mine

bank of the trail leading to the Chinese junk *Ning Po*, where hundreds of tourists pass daily to view the Oriental pirate ship. Some of the ore at this point assays as high as one hundred dollars a ton.

Fourth of July Harbor is the nearby cove on the north. Here another vein has been uncovered with similar valuable ore of silver and of lead. At Cherry Valley, the site of the Pasadena boy scout camp, is one of the first prospects explored by Wrigley. A tunnel was drifted for 410 feet into the west bank and a rich vein of silver and lead struck at 325 feet. This vein is about 25 feet in length and is heavy in valuable ore. East of Mt. Black Jack has been found a copper deposit running about 156 dollars per ton.

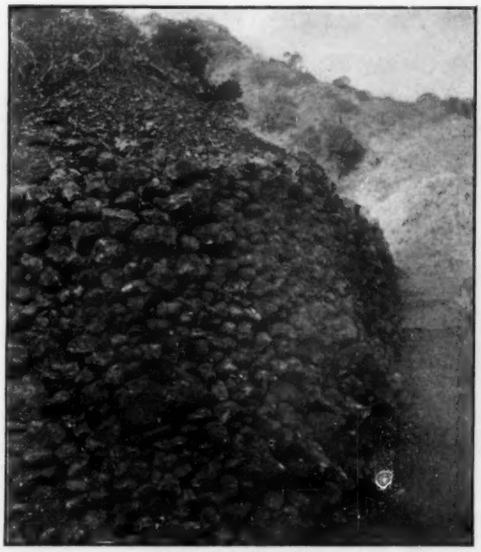
The mine which to date has been most extensively developed on Catalina Island is at the summit of Mt. Black Jack, 2,100 feet elevation. Black Jack is the second highest mountain on the island, and about 20 miles from Avalon, the center of the summer resort colony.

A Vein 26 Feet Wide

Already 100,000 dollars in high-grade ore has been shipped to northern smelters from this mine which now supplies the ore for the flotation mill. The main shaft is at a 475-foot depth. Assays of some ore from this mine run as high as 347 dollars per ton in silver, lead and zinc. The mine is electrically equipped, the power lines being brought over the mountains from Avalon. Roads had to be blazed through virgin undergrowth and over steep grades and blasted through solid rock to allow the ore to be brought on auto trucks from the mine to the boats, it being a down-hill run of about three miles. All this was done in less than six months.

Four miles distant at White's Landing, the oldest Indian burying ground discovered by scientists on the Channel Islands—and from which priceless relics have been taken—is the flotation mill. Experts had claimed that it would take at least six months to install this plant. In 54 days the last bolt was in place and the big wheels began to grind out the silver treasure. Fresh water is unavailable for milling purposes at this point of the island and therefore salt water was tried.

From the mill at White's Landing, 350 tons of zinc concentrates were shipped directly to Belgium during the first week in February. This was the first European shipment of zinc from the Wrigley mines at Catalina. Belgium is greatly in need of zinc and in the future Catalina Island will be one of that country's valuable sources of mineral supply.



A VALUABLE PILE

This is the form of the mined silver ore when it is ready to be shipped to the smelter for refining

Out on a pier which has been built for the shipping of the ore are piled sacks upon sacks of silver and lead concentrates, all neatly marked "Catalina" with red ochre—the same material used by the Indians centuries ago—which a workman found made a better stencil than modern paints. A ship, when ready to leave the pier with its consignment to the northern smelter at Shelby, near San Francisco, will have on board a cargo worth 150,000 dollars. When shipped via rail the concentrates will run 10,000 dollars per car. And the Spanish explorers sailed on—looking for a treasure isle!

With the discoveries being made at the Avalon end of the island, Wrigley is planning for a second flotation mill to be erected at Pebbly Beach. Here the great quarry which supplies crushed rock at the rate of 2,000 tons per day for the paving of Los Angeles city streets, has had to shift its operations because of running into a silver and lead vein so rich in minerals as to be unsuitable for the contractors. The rock proved too soft to hold up under heavy traffic. The big steam shovels which had been digging the rock were then transported further on and a crew of miners stepped into the excavation and took the places of the quarrymen.

Just around the corner of the island, near Seal Rocks, has been discovered the Renton Vein, the richest mineral strike on Catalina to date. Here a cross-cut reveals a vein 26 feet in width. The outcrop can be traced for nearly two miles over the mountain toward Silver Canyon. A tunnel has been drifted in 1,000 feet above sea level up a sheer cliff, with two other tunnels each 100 feet lower. It is estimated that this mine alone will keep another flotation plant in full operation.

Steam shovels and several crews of men are now at work constructing a road and laying power lines to this newest Catalina mine. The prospect of other mines does not stop at Renton Vein, however, for there are other possibilities on the Avalon side of the island. Even Mr. Wrigley's palatial home atop Mt. Ada has been discovered to be located directly over a silver vein. Another one has been found beneath the Catalina Radio Broadcasting Station, KFWO.

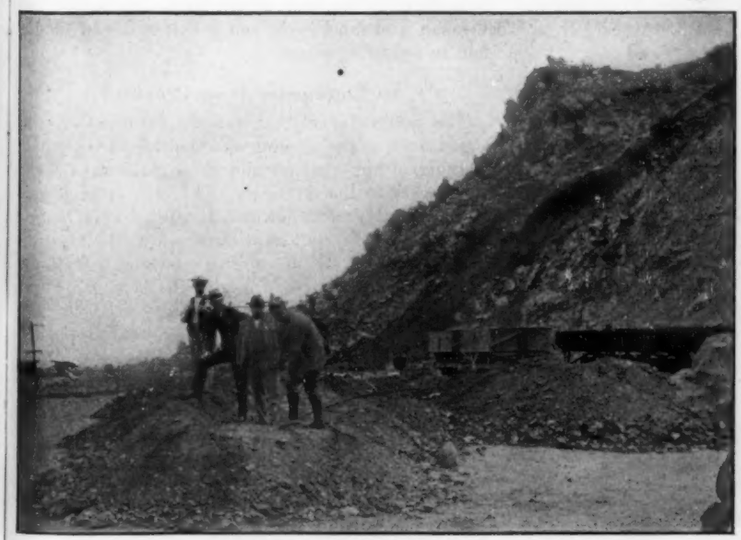
A Silver Golf Course

Three new mining prospects have been discovered just back of the island city of Avalon on the edge of the Catalina Country Club golf links. Offending rocks which ambitious players have been striking when "plowing up the ground" with their mashies, are found to assay high values.

Wrigley, while on an inspection tour of the new Catalina golf links under course of construction adjoining the present greens, found three outcrops of veins where stakes had been driven for tees. Workmen are now sinking test shafts and assays of the surface ores are being made. The new mines will be known as the "Wrigley Three." Indications are that these mines will be the richest of any so far being developed in the island—according to assays made, which run for some ore as high as 70 dollars per ton in silver and 145 dollars in lead and zinc.

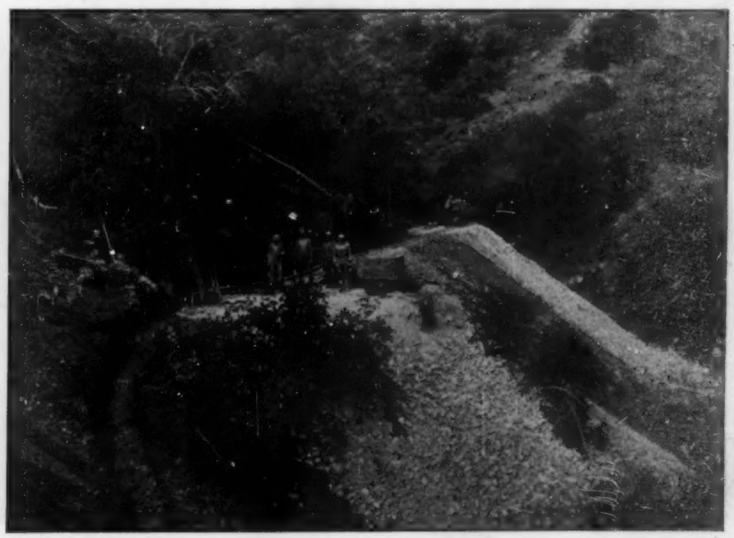
Some of the recent outstanding shipments and mining activity on the island are as follows: 150 tons of silver-lead ore are being transported daily from the Renton Vein to the White's Landing flotation mill for reduction into mineral concentrates. The Black Jack mine is producing in the neighborhood of 100 tons daily, which makes it necessary for the mill to run at full capacity on three shifts during 24 hours.

Early in March two shipments of silver-lead concentrates of 46 tons each and worth approximately 15,000 dollars per shipment were made to the smelter, while 500 tons of zinc concentrates were shipped recently to Dunkirk, France.



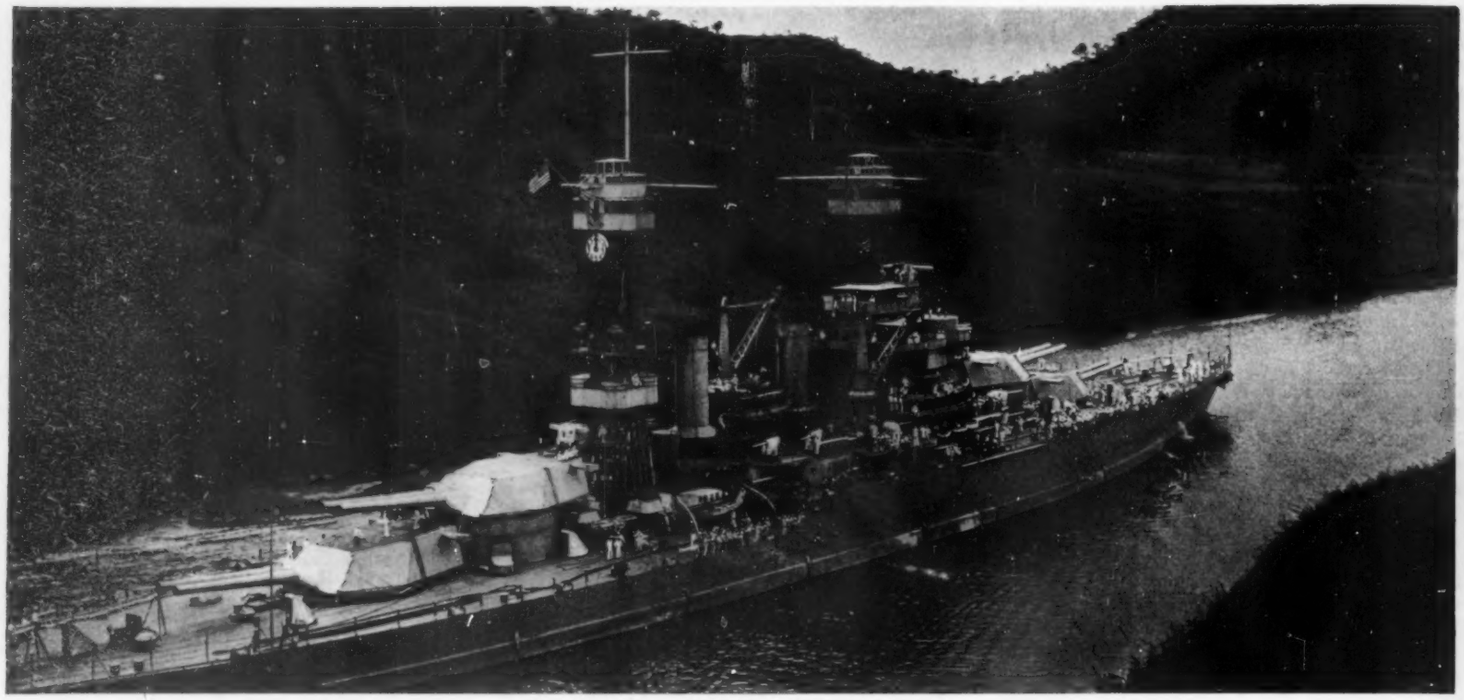
LAYING THE ORE CAR TRACKS

This photograph shows how it has been necessary to fill in the land at the base of Mt. Black Jack in order to allow for the building of the tracks for the dump cars



ONE OF THE SMALLER MINES

The topography of the mining territory of Catalina is clearly shown in this photograph. A group of miners are standing before the mouth of one of the mine shafts



THE CUT THROUGH THE MOUNTAIN DIVIDE
Battleship Colorado *in Gaillard Cut, near Cucaracha Slide, September 3, 1924*

The Panama Canal Today

During the First Ten Years of Operation, the Earnings of the Canal, Excluding Interest, Exceeded Expenses by Over Thirty-three Million Dollars

By J. Bernard Walker

TO make a trip to the west coast "by the Canal" is one of the most popular excursions of the day, and justly so. Not only is the Canal one of the most important links in the great trade routes of the world, but, judged from the spectacular side, it is one of the most majestic and inspiring works of construction ever achieved by the hand of man.

It is difficult for the traveler who passes through the imposing flights of locks at Gatun and steams across the far-spreading, artificial sea bearing the same name, and then moves cautiously but surely through that great gash through the mountain divide, known as Culebra Cut, and drops down through the locks to sea level on the Pacific—it is difficult, we say, to realize that it took much persuasion and long debate to make the country realize that it was possible and desirable to build this great waterway across the Isthmus of Panama.

The Canal Is Half Lake

For several years, indeed, the good people of the United States were undecided as to whether they should cut a 40-mile canal at Panama or a 110-mile canal at Nicaragua. We now know that the one scheme was as impracticable as the other has proved to be both practical, and, commercially, a brilliant success.

Before passing on to a consideration of the operation of the Canal during the first ten years of its existence, we will briefly refresh our minds as to the physical features of this truly wonderful engineering achievement.

In the first place, let us remember that the Canal does not run east and west but because of the easterly and westerly lay of the Isthmus at this location, the Canal runs more nearly north and south. It is approached by several miles of a dredged channel at each end, its entire length from deep water in the Atlantic to deep water in the Pacific being about 50 miles, and its length from shore line to shore line about 40 miles.

The Canal is of the lock type and for about one-half of its length, it traverses an artificial inland fresh-water lake known as Gatun Lake, whose surface is 85 feet above sea level. This lake was formed by building a huge earth dam which is half a mile in width at its base, across the valley of the Chagres River. Alongside this dam are the locks, three in number. These, like all the locks throughout the Canal, are built of concrete. They have a usable length of 1,000 feet and a width of 110 feet. At its westerly end, the lake is continued as a 300-foot bottom depth channel through the Gaillard Cut, nine miles in length. At the westerly end of the Culebra Cut, a single flight of locks at Pedro Miguel serves to lower shipping to Miraflores Lake, an artificial body of water from which the vessels are lowered by a flight of two locks to sea level. They continue through a channel eight and a half miles in length and so out to deep water.

BATTLESHIP *MARYLAND* IN GATUN LOCKS
The ship is being towed, at two miles per hour, by powerful electric trolleys running on the dock walls. She does not use her own power

An Emergency Dam Provided

The power for all the varied operations of the Canal, such as the opening and shutting of the gates, lighting of the channel and the provision of light and power at the terminals and shops at each end of the Canal, and so forth, is furnished by a hydro-electric plant at the Gatun Dam, where the head of water provided by the 85-foot elevation of Gatun Lake is utilized to furnish the electric energy required for the above operations.

The Chagres River is the source of supply of water for the Canal and its out-flow, which in times of flood is enormous, serves to maintain the elevation of the water in Gatun Lake at from 80 to 87 feet above sea-level, the height being determined by the balance between the rainfall and the loss of water through lockages, through operating the hydro-electric plant, and from the surface evaporation of the lake. The surplus waters pass through a concrete spillway formed in the center of Gatun Dam, the outflow being controlled by gates on the crest of the dam. It should be mentioned that the depth

EN ROUTE ATLANTIC TO PACIFIC

The steamship Belgenland, *of 35,390 tons displacement, passing through Gaillard Cut, December 12, 1924, on her world voyage. Largest merchant ship to transit the Canal*

of water over the sills of the locks is forty feet in salt water and forty-one and one-third feet in fresh water.

The ships do not pass through the locks under their own power, since, through a misunderstanding of orders between the bridge and the engine room, there would be a continual risk of collision. To prevent this, the vessels are towed through the locks by electric locomotives running on tracks on the top of the lock walls. The speed is limited to two miles an hour.

To guard against an approaching vessel colliding with the gates, breaking them down and letting the waters of Gatun Lake run out to sea, various protective devices have been installed. First, there are massive fender chains stretched across the entrance, each weighing about 12 tons. These are placed on the upstream side of the locks. A further protection consists of double gates, which are provided at the entrance to all the locks and at the lower end of the upper lock in each flight.

If an unmanageable ship should break through the chains and smash down the gates, there is provided an emergency dam, which is really a massive turntable structure, which can be swung across the Canal entrance and by means of a series of steel plates, lowered upon it, would serve to close the entrance and prevent the waters of the lake from rushing down through the locks and wrecking them.

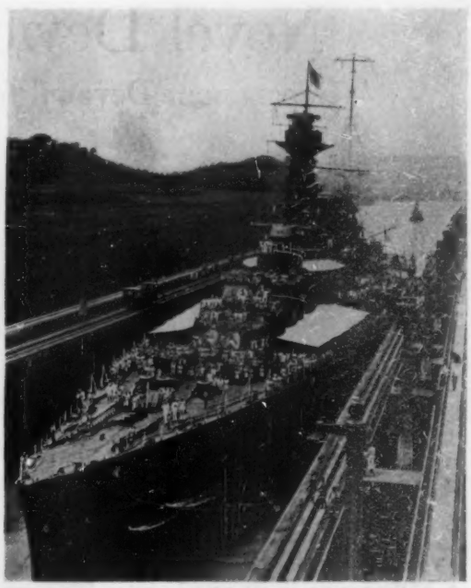
The first ten years of operation have fully justified the national policy which led the country to purchase the Canal from the French and complete it on a greatly enlarged scale. This is proved by the following facts, which are strictly official:

The vast sums of money invested on the Canal were spent partly for national defense and partly for commercial purposes. At the beginning of 1924, the investment charged to national defense was about $112,000,000 and that charged to commercial use was $275,000,000. Commercially considered, then, the Canal cost $275,000,000. The annual interest on this investment at three percent would be $8,250,000. The annual expenses do not include this interest charge, but do include an annual charge of $655,370.50 for amortization, et cetera, and a charge of $500,000 annually for depreciation.

Canal Now Showing a Profit

For the first four years of operation, the cost of the enormous slides in the Culebra Cut caused the revenues from tolls, and so forth, to fall below the expenses. In later years revenues have exceeded the cost of operation and maintenance. Thus, to June 30, 1924, operation cost about $70,000,000 but the revenues amounted to $100,000,000, of which over $97,000,000 was secured from Canal tolls. In addition, the extensive auxiliary plant, docks, coal and oil, storage, machine shops and so forth, cost for operation $100,000,000 as against business revenues from these sources of over $103,000,000. The excess of total earnings over expenses at the beginning of the fiscal year, July 1, 1924, stood at $33,241,425. This does not include the $8,250,000 annual interest on the original cost of the Canal above referred to. For the ten-year period this interest charge would now amount to $82,500,000, and subtracting the above $33,000,000 operating surplus, this charge would leave a deficit of $50,000,000 for the ten-year period.

The total earnings of the Panama Canal during the banner year which closed June 30, 1924, were $37,650,631 of which $24,289,603 was secured from tolls. The corresponding expense of operation and maintenance including depreciation but excluding, as mentioned above, the interest on the original cost



THE *HOOD* ENTERS MIRAFLORES LOCKS

World's largest warship. Length, 860 feet; beam, 105 feet, 2½ inches; displacement, 45,200 tons. Less than 2½ feet clearance between the ship and the dock walls

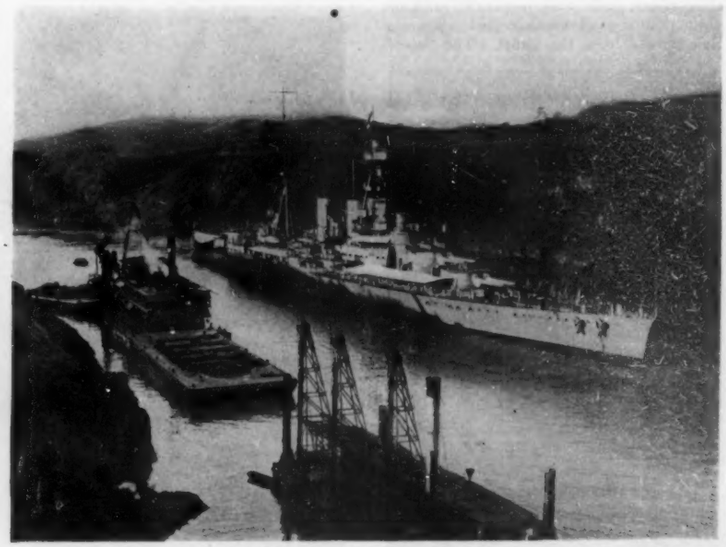
of the Canal, was $20,441,059 leaving net revenues of $17,209,573. This, it should be noted, is more than double the annual interest figure and provides a surplus of about $9,000,000 to be applied to wipe out the deficit of previous years.

The rapid increase in traffic passing through the Canal during the few years preceding and including 1924 was due largely to the great discoveries of fruitful oil fields in California and the large number of tankers that conveyed the oil from the Pacific to the Atlantic. The Canal did less business during the fiscal year 1925 than during 1924 which was a record year. The number of vessels in transit that had to pay tolls declined from 5,230 to 4,673 and the gross revenues from tolls fell from $24,290,964 to $21,400,524. This was due entirely to the slump in California oil: but with oil excluded from the list, the 1925 traffic shows a normal growth.

¶ *The Great Lakes are down two feet. Five inches are due to the Chicago Drainage Canal, nineteen inches to decreased rainfall. In our August issue we shall give the facts and suggest a remedy.*

IN THE CHANNEL OF THE ATLANTIC ENTRANCE

A general view of Cristobal terminus at the Atlantic end of the Panama Canal. Here are substantial docks and facilities for bunkering ships with coal and oil



ROUNDING A TURN AT PILA POINT

In spite of her great length and beam, the Hood *was taken through the channels and locks without a hitch, reflecting high credit on the canal operating staff*

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

A pie plate for juicy pies

You Can Eat the Lower Crust

A NEW invention in pie pans is just out. It comprises the old pan with a deflecting wall of a circumferential construction that deflects the juices from the pie and prevents it from entering between the pan and the pie. Adjacent to the deflecting wall is a hollow part that catches the juices so deflected and prevents the juice from entering the oven of the stove.

Comfort on the Motor Bus

THE accompanying photos show how wicker seats for the upper deck of a double deck motor bus have been specially woven to conform with the contour of the deck. The wicker seats are built in three sections and are removable, facilitating the cleaning of the top deck. A windshield is also provided for the occupants of the front seats, as shown in the lower engraving.

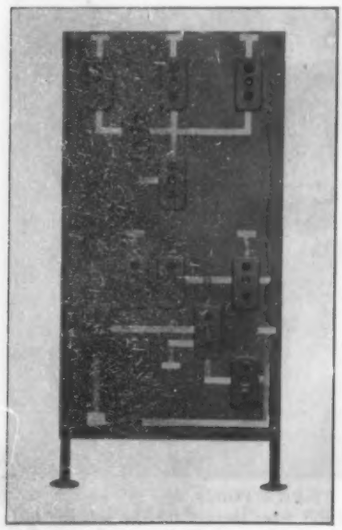
Novel Steam Line Control

THE accompanying photograph illustrates a new and interesting "twist" in the remote control of steam lines.

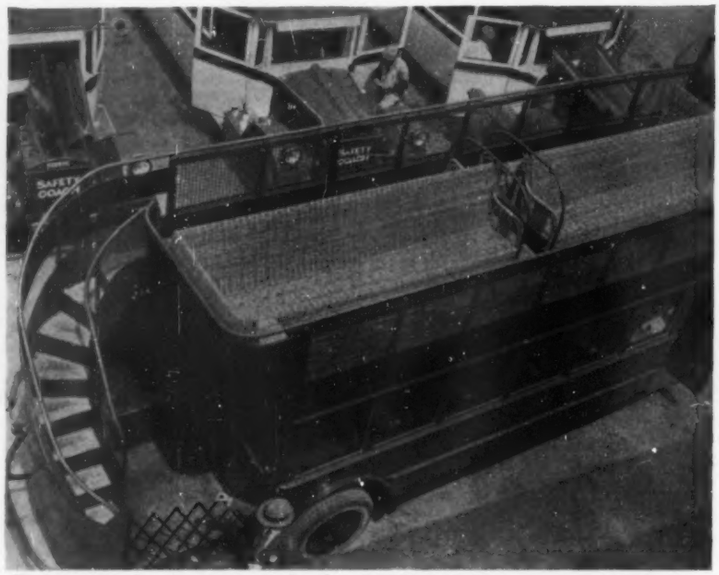
The mimic busses and nameplates shown on the black panel are of polished copper. The busses represent steam lines and the nameplates are engraved with the size of pipe to a particular boiler, size of pipe to a particular turbine unit or the location of valves.

The pushbutton stations are used only to close valves, each being in parallel with the closing buttons of another pushbutton station remote from the panel. The "open" control is located at the remote pushbutton station.

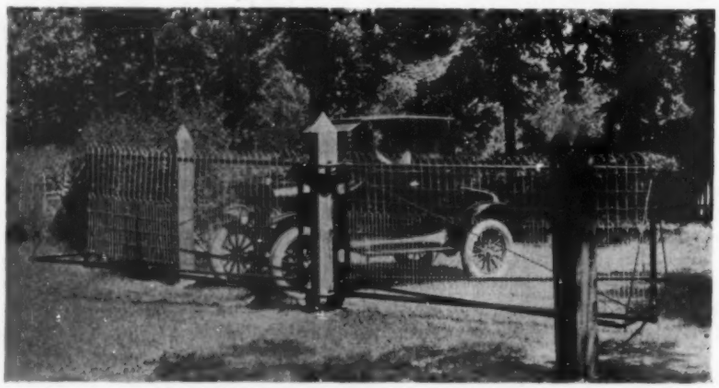
Each group of pushbuttons has three buttons. The topmost button controls the valve which feeds a high pressure steam line.



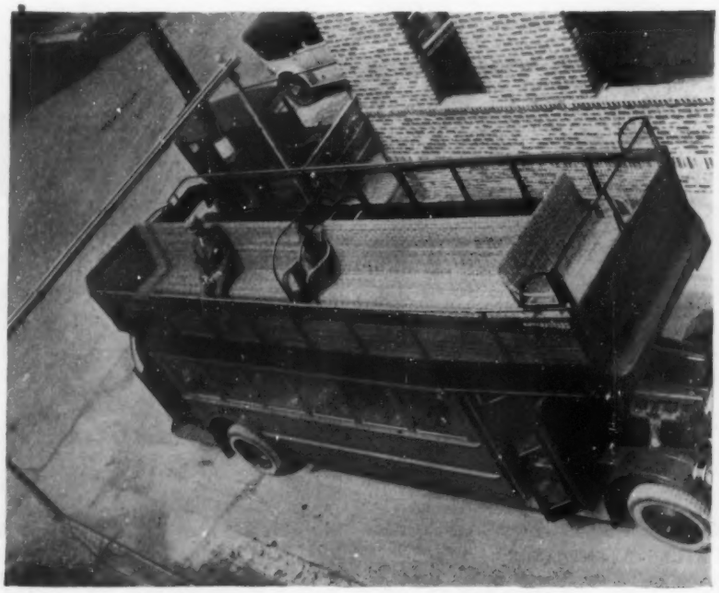
Panel for control of steam valves



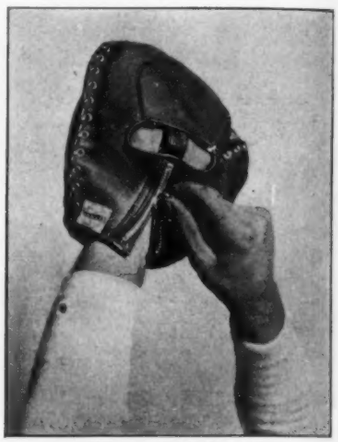
Wicker seats for the upper deck of a double deck bus are a novelty and are specially woven to conform with the contour of the deck



Bump your car against the gate and it opens



Another type of wicker seats for the top of a bus



A zipper catcher's mitt

The Catcher Takes No Chances

A NEW idea in baseball for the catcher's mitt is the so-called "zip-on" fastener that gives a secure feeling and keeps the mitt firm on the hand. The opening at the back on the back of the knuckles ventilates and makes the mitt more flexible.

Automobile Turnstile

WITH the auto turnstile, you simply drive the front wheels of your car at slow speed against the gate bumper and follow through as the gate begins to swing. The gate automatically completes a half circle turn, stopping when in closed position behind you. The gate returns automatically by gravity.

Safety for the Bowler

TO prevent the bowler from slipping as he throws the heavy wooden ball down the alley, attachments of a material that will not slide on the floor have recently been invented to be worn on the shoes. They can quickly be slipped on or off, thus making it possible for the bowler to use his street shoes in the game and save the soles of these from the wear that results when no attachments are worn.

Anti-slip for the bowler

An electric trouble finder

Handy Testing Outfit

WITH this new testing outfit, the handy man around the home, or in the garage or private shop, has a means of diagnosing electrical trouble with very little difficulty. This outfit has a special separable plug that fits any standard lamp socket or receptacle. It can be used on either alternating or direct current, enabling its user to discover and locate short circuits, grounded circuits and open circuits.

A Novel Pepper Mill

A LARGE dealer in household equipment brought back from England an ingenious novelty some months ago. This is a pepper mill in the form of a miniature silver siphon. The whole peppers are inserted through an orifice in the bottom and a turn of the top is sufficient to grind the pepper.

A deceptive siphon

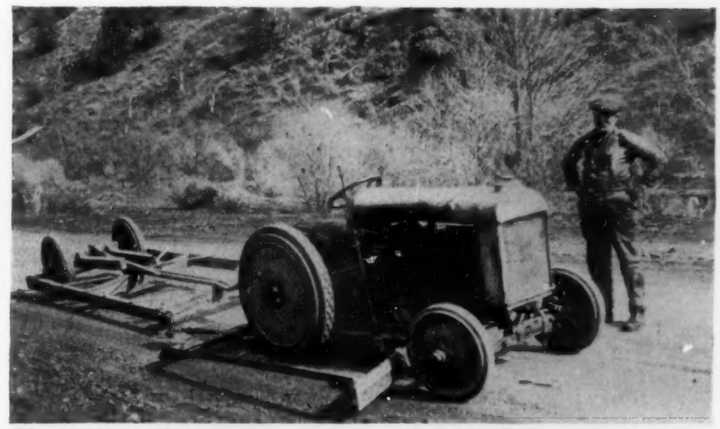
A Nutcracker of Great Leverage

OUR engraving shows an extremely powerful nutcracker which is a recent importation from England. The construction is admirably shown.

A powerful nut-cracker

A Home Electric Dishwasher

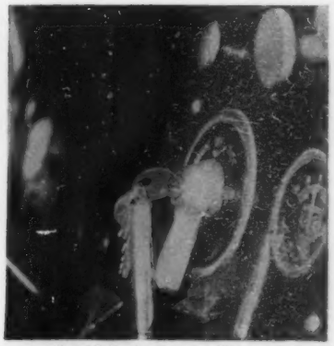
OUR engraving illustrates an electric dishwasher which may be placed in a butler's pantry or in the kitchen. A similar unit can be supplied, built in to a sink. When a load has accumulated—or after every meal—hot water and washing powder are introduced into the machine and the lid closed. A pressure of the switch starts the rotating dasher in action.



The California Highway Commission keep the roadways smooth with a drag made of an old automobile frame. The tractor moving the drag to position

The drag is shown here ready for helping to smooth the highway

A built-in electric dishwasher relieves the housewife of drudgery



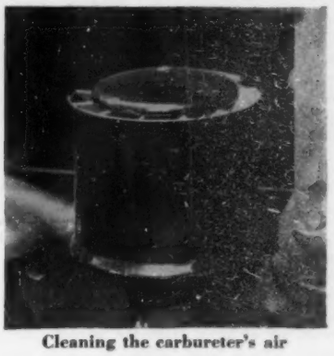
Avoid losing your license

Safeguarding the License

IN numerous localities a motorist's license is demanded on sight. In the device shown, a metal tube container holds the license. Ignition keys are attached to it and the license is rolled within the tube. It cannot work loose as the two sections of the container lock together.

Automobile Air Cleaner

THIS device attaches to the intake of the carbureter and separates out the dust and grit and allows nothing but dustless pure air to enter the internal combustion chambers.



Cleaning the carbureter's air

Getting the Juice from Citrus Fruits

THIS device is adopted for obtaining the juice of grape-fruit, oranges and lemons. The divided fruit is pressed against a cutting head of the correct size—one being adopted for grape-fruit, the second for oranges and the third for lemons. The juice passes through a strainer, thus separating the seeds.

A fruit juice extractor

A contented passenger

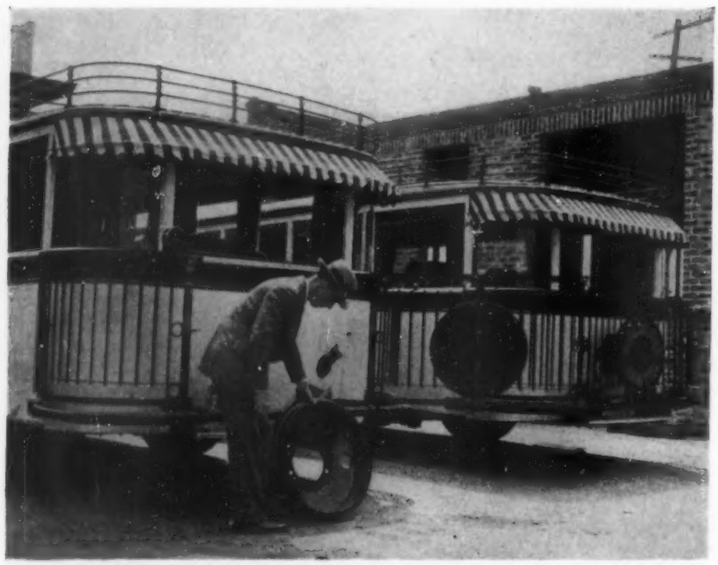
Keeps Baby on the Seat

THE transportation of young children in automobiles is more or less of a problem and each year sees a new crop of inventions relative to carrying babies and small children comfortably and in safety. We illustrate herewith a seat for the baby that keeps the child safe and comfortable while riding in an automobile. This is a valuable adjunct to motoring. This seat can be placed in any car. The cushion is removed and the metal frame of the seat is placed beneath it. The back frame bends to fit the car. Baby sits on the cushion of the car and leans back. The cloth is placed between the child's legs and fastens to the frame on each side.

Observation End Motor Parlor Cars

THE luxurious bus or "parlor car" is growing in popularity each season, and now long trips can be taken with a maximum of comfort. The great advantage in cars of this kind is that a much better idea of the countryside can be gained than could be obtained from the windows of a train. People think nothing of taking such a journey in one of these luxurious parlor cars from say, Boston to New York.

The accompanying photos show some of the interesting features of a parlor-car bus with an "observation" end. There is an artistic metal railing extending around the rear of the car. The center portion of the railing is hinged, permitting it to be swung open to give access to the spare wheel and tire carried on the back of the car. The spare wheel and tire are hidden from public view by the illuminated advertising sign when the center portion of the railing is closed. This sign is painted in red letters, and being perforated, the rays of light from an electric bulb are thrown to the rear, producing an artistic effect at night. The railing along the back of the car also enables the driver to reach any part of the baggage rack arranged on the top. Special steps are attached to the railing to enable the driver or baggage man to quickly and easily reach the top of the railing and then by walking along the top of the railing, he can reach any part of the baggage rack. At the left rear of the bus there is a "stop" signal and tail light operated by a battery system of twelve volts. There is a special rear bumper made of two and one half inch pipe flattened at the ends and bolted to the rear of the car which both protects the metal railing and the rear of the bus. The gasoline filling spout is at the rear.



Observation end for motor parlor car showing tire carrier

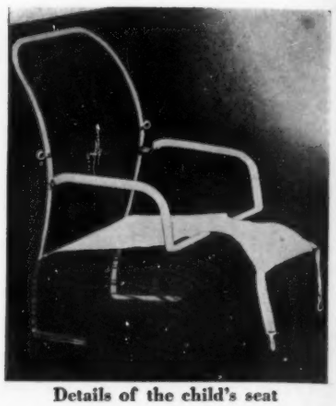
A "four-in-one" street cleaner and washer used in Berlin

A demonstration water valve

Escalators Displacing Elevators

THE new escalators at Trafalgar Square Station, London, on the Baker Street and Waterloo Railway, have now been opened and the elevators closed. The space occupied by the latter will now be devoted to new and larger ticket offices which will be able to deal with 8,000,000 passengers a year instead of 4,000,000 as at present.

A fleet of observation motor parlor cars ready for passengers



Details of the child's seat

Novel Stairway Noses

THE edges of steps of concrete stairways should be provided with nose pieces particularly if material of any kind is to be moved either up or down over them. The *Coal Age* shows how scrap material can be used for this purpose. The nose of each step is protected by a piece of pipe cast into the concrete and extending into the retaining or wing wall upon either side.

Street Cleaning in Berlin

WE illustrate a new motor watering cart which combines also other utilities such as a snow-plow, sweeping machine and fire extinguisher. Our engraving shows the motor in use as a watering cart. The snow plow and the sweeping appliances can be seen at the front of the machine.

Teaching Firemen to Handle High Pressure Valves

THE San Francisco Fire Department has installed one of the high pressure valves used in the city water lines for fire protection on a four wheel truck and has built a portable platform for use in instructing firemen in the proper method of opening and closing the valve. The firemen stand on the elevated platform when opening the valve, it being necessary to make one hundred and seventy-six turns with the large hand wheel. This usually requires about five minutes. The pipes and valves actually in use in the high pressure fire protection system in San Francisco, are at times under pressure as high as three hundred pounds.

Baby Carriage with Parcel Carrier

WHEN taking the baby for a ride, the modern mother need not load the baby up with the parcels that she purchases along the way. The package carrier on the back of this carriage takes care of all this. Besides being one of the lightest baby carriers made, this "cart" may be folded up and taken along on a trip in the car.

Double duty for the baby carriage

Portable electric heater

You Can Pick Up this Heater

THIS handy electric heater is practical for many uses, such as for drying hair, warming cold beds and even as an aid to starting the automobile engine. When used as a small room-heater, it is placed upon its three legs.

An Automatic Train Stop

THE New York Central Railroad has shown commendable enterprise in the speed with which it is equipping its lines with automatic train control. Up to a few months ago 1,165 locomotives, operative over

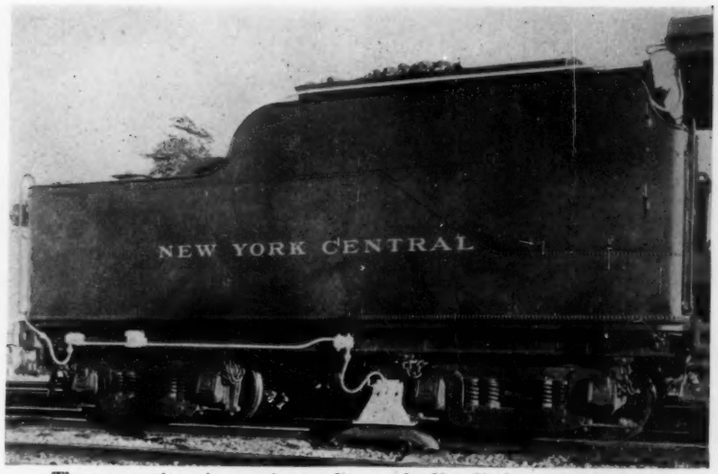
Blow torch used as soldering iron

871 miles of line and 2,398 miles of track had been provided with the device. Additional mileage is being added constantly. The mechanism of the automatic train stop consists of a device fastened alongside the track, controlled by block signals. The locomotive carries another part, called the "receiver." When the receivers on a passing locomotive approach a prohibited area, the brakes of the locomotive are applied automatically and the engine must come to a full stop before they can be released.

Three-in-One Footwear

FOOT toboggans, combined with snow-shoes and skis for the pleasure of children, provide a new winter sport. They have recently been invented and are now being manufactured in Missouri. Coasting on these sleds for the feet provides new snow thrills, it is said.

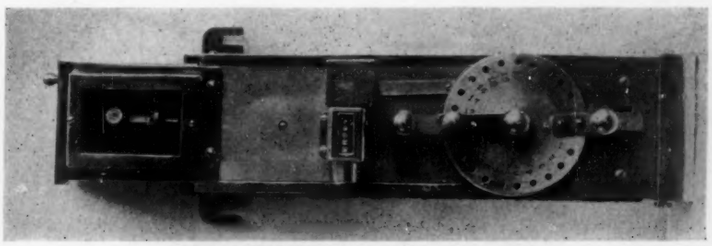
A new thrill for the winter



The automatic train stop is a reality on the New York Central Railroad

Soldering Iron and Torch

HERE is one of the handiest tools that a person can have around the house. It is a combination soldering iron and blow torch. No pump or pressure system is needed to operate it. Just fill the hollow handle of the iron with gasoline, light it, and in less than three minutes the iron is ready for use. To use it as a soldering iron, simply screw in the copper tip and proceed.



The controlling and recording mechanism

A speedy photographic duplicator

Can also be used for fire purposes

This Hose Won't Kink

HERE is a hose reel that will not kink the hose. It works like the fire-hose reels you see in public buildings. The axis of the reel is hollow, and the short length of hose that attaches it to the water system is connected to a swiveling joint at one end of this axis. Seize the nozzle and run out

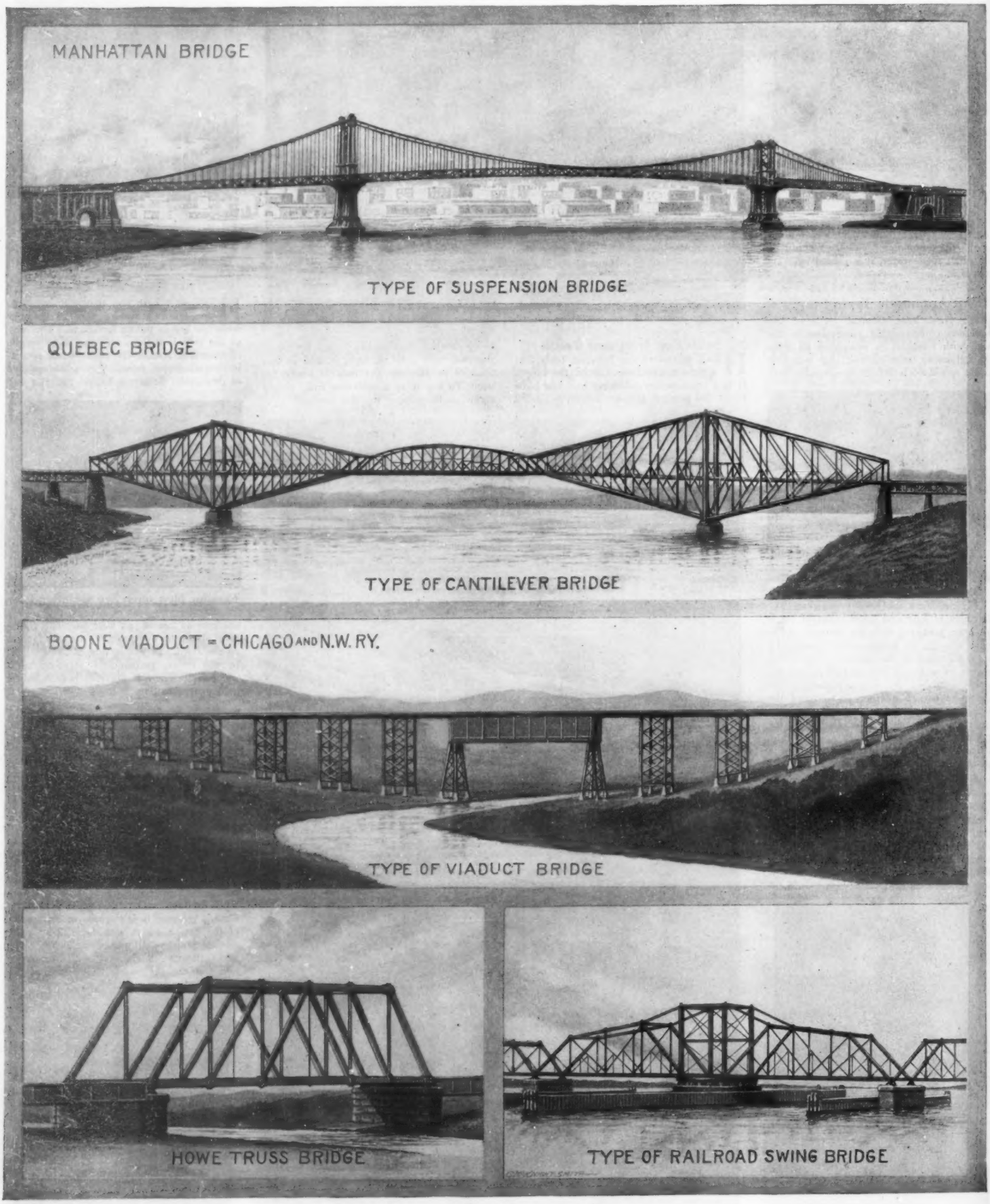
Gasoline blow torch and soldering iron

the hose as fast as you want to. The equipment shown on this page is primarily for use on the lawn. In winter time it can be kept in the cellar, permanently attached to a water tap. There it provides instant household fire protection.

A Rapid Photographic Printer

NEWS photo services and photographers requiring a large number of proofs will find this machine extremely speedy and economical. An automatic counter and timer serves to turn on and off the electric light and also keep track of the number of prints exposed. The use of a powerful light would soon destroy the film if it were not protected from undue heat by a special cooling device. The warm air is forced from the printing chamber and cool air is forced into it. The prints all have uniform exposure by means of springs which insure an even contact. The cooling arrangement already referred to is the most novel feature of the device, which was invented by Commodore Matthew J. Steffins of Chicago. The small illustration shows the timing device and the counter which takes care of the number of prints.

Toboggan, snow shoe and ski



Types of Modern Bridges

ADJUSTING THE EYES OF THE CAMEL

Papier mache animals, to be lifelike require mechanical "insides" which are here shown, beside the motor. Foote reduction gears actuate the mechanism for turning the eyes, ears and operating the tongue of the camel

THE "INSIDES" OF A SMALL DINOSAUR

This miniature mechanical dinosaur which is only eight feet long was built for display for advertising Sir Arthur Conan Doyle's "The Lost World." Its body, head, eyes and tongue move in a natural and life-like manner

MAKING THE PAPER FIGURES

Girls are all deftly "laying in" wet paper. As many as fifteen superimposed layers of "bogus" paper are laid in large molds. After the paper is thoroughly dried, it is trimmed where necessary and sandpapered smooth just like wood. Papier mache can be fastened with nails and screws

Paper Sculpture

The production of figures and animals in papier mache is not new. The manufacture of such objects has been going on for many years. Now, however, with the aid of clever motors and reduction gears, it is possible to give slow and accurate motion to various animals. A huge mammoth is now being constructed in the studio of Messrs. Messmore and Damon, New York City. In this studio are buffaloes, tigers, lions, giraffes and other animals. A switch is thrown and the animals begin to move at once giving a very realistic and jungle-like effect.

PAINTING THE BRONTOSAURUS

This little relic of bygone days is forty-seven feet in length and nine and one-half feet high and is moved with the aid of ten motors. The eyes, head, neck, ears and stomach move. He almost looks as though he were going to take a drink from the pail of paint

ADJUSTING THE ACROBATIC CLOWN

The papier mache body is filled with machinery which sways the body and contorts the legs. The clown's body works in a circular motion and when the entire display is fully assembled there is a little mechanical dog in front of the clown that wags its tail

The Scientific American Digest

Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Astrophysicist Travels 30,000 Miles in Interests of Long-Range Weather Forecasting Research

To find the one spot in the eastern half of the world where the sun's radiation can best be measured, Dr. Charles G. Abbot, director of the National Geographic Society's Solar Radiation Expedition in cooperation with the Smithsonian Institution, has just completed a journey of six months in which he traveled 30,000 miles. His investigations took him to the edge of the Sahara in Algeria, to the sandy wastes stretching back from the Nile, to the Sinai peninsula, where Moses received the commandments from God, to the home of the wild warrior tribes of the hills of Baluchistan, and at last to the land of the Hottentots of Southwest Africa. There, on an isolated, precipitous peak, he found his goal, and there caves are now being fitted out to receive two American observers and their delicate instruments for measuring the sun's radiation. One more essential step in the attempt to make possible weather forecasting weeks and even months ahead has thus been taken.

For long-range weather forecasting is the ultimate probable result of the Smithsonian studies of the sun, of which Dr. Abbot's expedition for the National Geographic Expedition is a part. To explain the expedition's place in these studies will require an understanding of their present status.

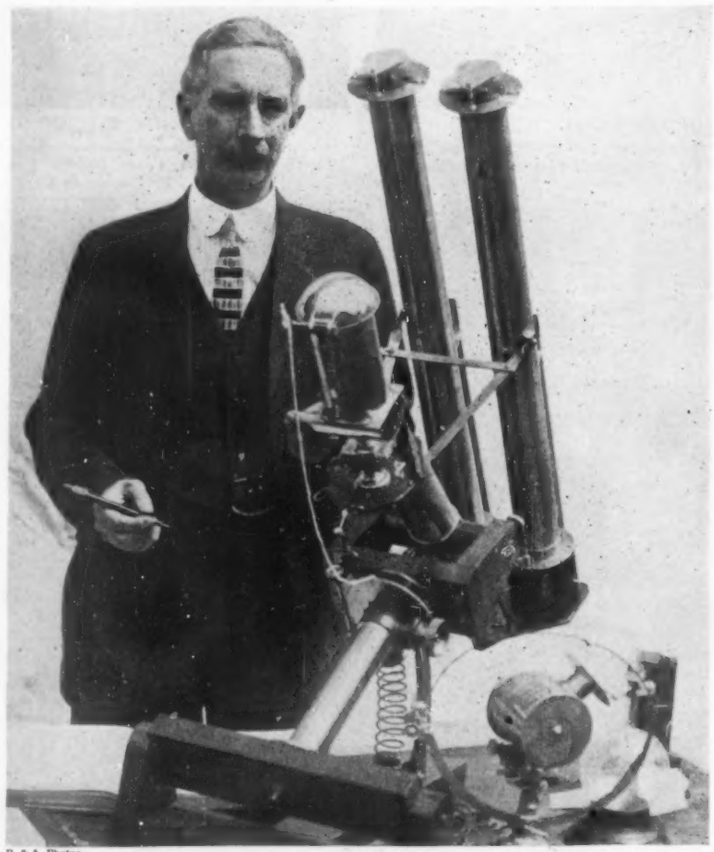
For more than 30 years the Smithsonian Institution has been measuring the sun's light and heat. By 1903, the Institution's scientists began to think that solar radiation varied from day to day and from year to year. They tested this conclusion by measurements at stations ranging from sea level to Mt. Whitney, three miles high, and from California to the Deserts of Sahara and Chile, over many years of study before they allowed themselves to fully believe it. By 1925 conclusive proof had been developed that this variation influenced the earth's weather. The manner in which this influence is brought to bear, however, is very complex and has not yet been fully unraveled. But it seems demonstrated that a variation as small as one-half of one per cent is sufficient to produce really noticeable changes in weather. For this reason it is vital that the measurements of solar radiation be accurate to the highest degree. To increase this accuracy is the main reason for the establishment of a new station in the Eastern Hemisphere. Daily measurements from this station will check those made at the two stations in California and Chile, which the Smithsonian already has.

The ideal spot for measuring solar radiation would be at the top of the earth's atmosphere. In choosing a site for the new station, therefore, Dr. Abbot had to seek a spot where conditions approximated as nearly as possible those at the top of the earth's atmosphere. First, the air had to be as pure as possible, free from dust and smoke; it had to be dry, because even a small amount of water vapor absorbs great quantities of solar radiation; it had to be rare, which condition could only be satisfied by choosing a high altitude; it had to be uniform and unchanging.

But these physical conditions were not all. The site had to be easy of access, so that complicated outfits and supplies could reach the station; and under stable, enlightened governments, safe from theft and massacre, and where supplies and society could be found.

To meet all these difficult conditions was no simple task. Dr. Abbot's first objective was the summit of Djebel Mekter, a peak 7,000 feet high, near the military post of Ain Sefra in French Algeria. Dr. Abbot climbed the peak, but he was only moderately favorably impressed with the sky conditions.

Egypt, Dr. Abbot's next stop, boasts of its cloudlessness, but the desert lacks easily accessible peaks necessary to getting above the haze and sandstorms. Dr. Abbot learned of a mountain on the border of the Sudan where no rain ever falls, but to reach it required a 200-mile journey over sand from the nearest water. Mount Sinai, where Moses received the Law also had to be crossed off the list of possibilities because of the difficulty of access, the bleakness of its winters and several other drawbacks.



P. & A. Photos

Dr. Charles G. Abbot and his invention, the silver-disk pyroheliometer for measuring the heat of the sun's rays, which is being used by the Smithsonian Institution in connection with Dr. Abbot's new method of weather prediction

Dr. Abbot left northern Africa and Asia Minor little cheered by the sites they offered. His next objective was the region about Quetta in British Baluchistan. The first condition to be met in considering a site in this stamping ground of the warlike hill tribes was the safety of the observers. Formerly the savage hill men used to pour out on the plains of Delhi on raiding expeditions. The British have established posts in Baluchistan and easterly to put an end to this, but the hill men are no less worth watching for that. In going about in the neighborhood it is the regulation that each auto shall contain a loaded rifle and two men able to use it, besides the chauffeur. If ladies are to be of the party, two days' notice to the garrisons are required.

In such country as this Dr. Abbot inspected sites. He finally picked on Khojak Peak, 70 miles northwest of Quetta and only ten miles from the Afghan border. This peak is 7,500 feet high, and but half a mile from Khojak Pass.

The authorities, while they regarded the Khojak as one of the safest regions in their jurisdiction, imposed the conditions that the American observers, if they established themselves there, must live at the garrison post of Shelabagh three miles east; that a couple of enlisted natives must be continually at the observatory on the peak; and that a third must always ride on the auto to and fro. Against these disadvantages Khojak possessed the attraction of superb sky conditions. "Neither on Mount Whitney in California," said Dr. Abbot, "nor on Mount Montezuma in Chile, have I ever seen quite so pure a sky as I saw there."

Reserving decision on the Baluchistan site, Dr. Abbot set out to investigate his last possibility — Southwest Africa. Pushing through the big cities of the Union of South Africa he reached the upland country which has been given to the Hottentots as a reservation. He thus records his impressions of the heavens at night in this area:

"It was a glorious sky. At one time 16 of the 21 brightest stars of the whole heavens were visible. So exceedingly clear was the atmosphere that the great stars went blazing down to the very horizon and were blotted out, one by one, by the hills 30 miles away, with lightning-like suddeness. Before such an inspiring sight sleep came but fitfully." Dr. Abbot added that no one remembered any rain for ten months so that he could not but decide that if a site could be found, this was the ideal spot for his observatory.

The following day by auto and on foot, guided by a Hottentot, Dr. Abbot climbed Mount Brukkaros. "It is a strange mountain," he says of it. "Lying about 20 miles to the west of the railroad and 200 miles south of Windhoek, capital of Southwest Africa, Mt. Brukkaros sticks out as the only peak of consequence in a circle of at least 50 miles diameter. It is inaccessible on all sides excepting by the dry bed of a stream approaching a gradual ascent of about three miles from the south. The mountain is 5,200 feet above sea level and quite 2,000 feet above the plateau. Only four or five miles in its greatest length and with no neighboring peaks for many miles, its isolation and abruptness are really uncanny. The summit is like a cup with a flat bottom about half a mile in diameter and a steep rim 1,000 feet high.

Hours of exhausting scrambling finally revealed a suitable site for the tunnel 35 feet deep which will provide for the installation of the bolometer, an electrical thermometer, sensitive to a millionth of a degree, which therefore requires very constant temperature. The exposure was suitable to permit the sun's rays to be reflected in the cave within an hour of sunrise. Dr. Abbot therefore settled on this site, and the chief of the Department of Works of Southwest Africa is now engaged in getting it into shape.

Before finding the observatory site, Dr. Abbot had come upon a natural cave suitable for a dwelling for the observers. This required only moderate enlargement and the building of a front wall and partitions to make it the most satisfactory home possible in such a place. Warm in winter, the heating problem will be solved, and with a porch awning for summer, it will be the only cool place except the observatory on the mountain.

Such will be the home and the working quarters of two American observers for the next three years at least. The men are scarcely to be envied even by the most optimistic. They will be exiled on a barren crater in the wilderness, seven miles from even Hottentot neighbors and 60 miles from a fair-sized town. To cover even that seven miles they will have to scramble down a 60-foot precipice and then pick their way three miles over a stream bed to their automobile. They will have to haul their supplies over this route and derrick them up the precipice. There is no water in the cup itself, so that until the contemplated reservoir catches enough from the meagre rainfall they will have to haul this from the foot of the precipice.

What are the compensations for this isolation and loneliness? The phonograph, and the radio, of course, which will permit them to listen in on Cape Town and Johannesburg; books and games to fill their leisure hours; hunting of sorts,—springbucks, gemsbucks, koodoos and even leopards. But most important of all, a work which is absorbing in time and energy and which promises results for which any man might be proud to sacrifice himself. *For it is difficult to conceive of any scientific accomplishment whose results would be more immediate to every human being than that of the perfecting of long range weather forecasting.* It would remove much of the element of risk in the farmer's economic life, it would mean safety to the sailor and to the airman, it would mean the elimination of waste and loss to the business man and its economic significance would be incalculable.

The Smithsonian Institution, of course, does not propose to enter the field of weather forecasting. It is an institution for the learning of new facts for the increase of knowledge among men. What it is now seeking to do is to unravel the facts concerning the sun and its influence on weather.

When it has done this it will leave their application to other agencies.

The Smithsonian Astrophysical Observatory has concrete proof that it is on the right track. Since 1918, for instance, the Weather Bureau of Argentina has been making weekly forecasts on the solar constant values received from the Smithsonian observatory in Chile. These forecasts have proved so valuable that the government is able to sell them to business men and farmers.

Experiments with artificial lightning. Lightning either strikes a rod or strikes the ground at least four times the length of the rod away

From the point of view of safety, accessibility and sky conditions, Mt. Brukkaros was the most favorable spot found by Dr. Abbot for the observatory to be established with National Geographic Society funds. He expects to have good weather for observing every day throughout ten months of the year and three quarters of the time in the remaining two months—the so-called rainy season. Annual rainfall averages about 3 inches. Although the new station is not so high as the one in Chile, the dryness and clearness of the air are very extraordinary.

Having picked his spot, Dr. Abbot had to obtain a vote of the Hottentot tribe to permit him to locate there. This he got easily. In addition, the government of Southwest Africa proved cordial to the project and has assigned Mr. A. Dryden, Public Works Inspector, to build the observatory at cost. Free importation of the outfit is also guaranteed.

Meanwhile the outfit in America has been made ready. The two observers have been picked. They are Mr. W. H. Hoover and Mr. F. A. Greeley, both of whom have spent years under Dr. Abbot's direction on other observatories of the Smithsonian Institution. They will leave for Africa in July and it is hoped that observations will begin in September, and that daily reports will begin to be wired to Washington about six months later.

* * *

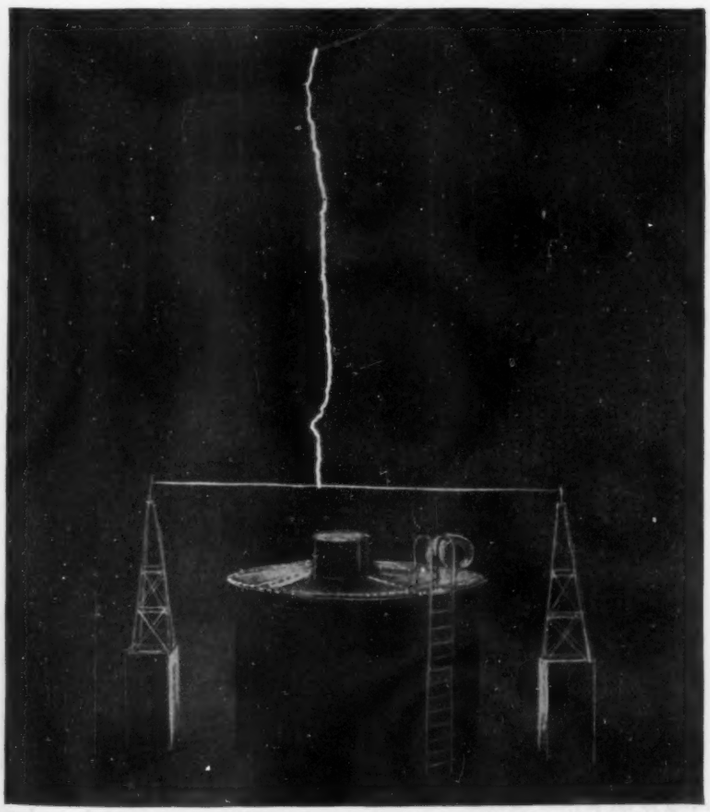
Protecting Oil Tanks From Lightning

THE recent oil fire in California, which resulted in the death of two men and the destruction of more than $10,000,000 in oil and property, was attributed to lightning. The lightning hazard is well known to the oil industry, and studies of protection methods have been made.

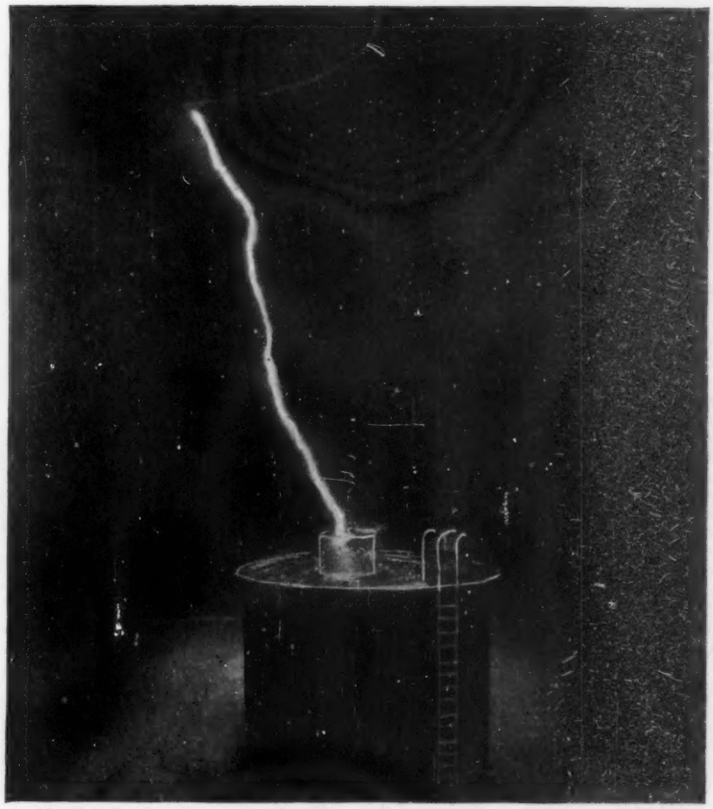
Oil storage tanks are necessarily so large that reinforced concrete tanks, rather than those of metal, must usually be used. These concrete reservoirs are frequently 500 feet in diameter, and sometimes in oval form as large as 600 by 1,200 feet and 30 feet deep. As many as 25 or more such tanks sometimes make up a "tank farm." The tops are of wood, often covered with felt as a protection from the heat of the sun and the consequent evaporation.

Very frequently, especially with certain types of oil, the space between the surface of the oil and the top of the tank becomes filled with an explosive mixture of air and oil vapors. In general, no lightning protection is used.

F. W. Peek, Jr., consulting engineer of the General Electric Company at Pittsfield, Mass., speaking at the annual meeting of the American Petroleum Institute in Los Angeles last January, described experiments which had been made in the Pittsfield laboratory with artificial lightning and miniature oil tanks, and told how protection from direct hits by lightning can be secured. The following, written from notes made during Mr. Peek's address, are of interest in view of the recent oil fires.



A wire strung over a tank protects it from direct strokes of artificial lightning



Artificial lightning makes a direct hit on an unprotected miniature oil tank in a demonstration of lightning protective measures

"In considering oil tanks, two cases must be kept in mind—the tank containing explosive mixtures and the tank free from such gases.

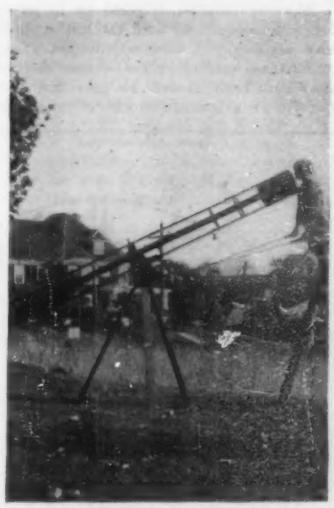
"Where there are explosive mixtures, the protection problem is exceedingly difficult. Just as a considerable voltage may appear on electrical transmission lines a mile or more from the lightning discharge, because of 'wireless' or induction effect, so may sparks be caused by voltages induced in metal parts of the tank, even though the tank is not struck directly by the lightning. A spark at 500 volts, caused by a lightning stroke several miles away, could ignite the mixture and cause great damage.

"If a tank were made completely of insulating material, there could be no spark, but there are always pipes, nails, conducting strips, and so on, more or less isolated. Grounded wires strung over the tank, as in the case of a protected transmission line, would reduce the voltages. A grounded two-inch net cage would reduce the voltages to about one-tenth. The hazard would be reduced, but it would only mean that the storm would have to come closer to cause the little spark. The only safe method where there is explosive gas is a complete metal tank, inside of which no sparks can occur. Even then, however, there is danger when projections extend from the surface.

"Where explosive mixtures of gases can be kept from the tank, the chance of induced voltages causing trouble is small. Direct hits, however, could set the oil-soaked roof on fire. There are a number of principles, discovered in the Pittsfield laboratory, that can be applied to prevent the tank from being struck. It has been found, for instance, that lightning never strikes the ground nearer a conducting rod than four times its height. If the lightning does not strike the rod, then it hits the ground some distance away. A number of rods properly placed about the tank would either take the hits or cause the lightning to strike the ground some distance away. Grounded wires strung over the tank, a grounded metal net or metal roof afford protection against direct hits. A tank made completely of metal is ideal here also.

"The researches, which showed that a man standing has 15 times the chance of being struck by lightning that a man flat on the ground has, showed that a storm discharging over a tank farm is likely to strike it. They also showed that it is the edge of a small tank which will always be struck, while the very large tanks may be hit anywhere.

"The investigations also showed that explosive gases may be set off by sparks produced by means other than lightning as, for instance, static sparks produced by friction."



This reflecting telescope cost less than ten dollars to make

Another Amateur's Telescope

THE description of a long-focus, Herschelian type, reflecting telescope has been received from Mr. A. B. Hayden, its maker, an attorney and an enthusiastic amateur telescope maker who lives in Manchester, New Hampshire. A photograph of the telescope is reproduced above.

The concave mirror has an aperture of 5¼ inches and a focal length of 112½ inches. The mounting is of the alt-azimuth type and has slow-motion handles in both altitude and azimuth. The mirror is mounted in an open framework, instead of a closed tube, and is protected from cross lights and reflections by a hood, shown at the rear or lower end of the telescope. The eyepiece is similarly protected. It is mounted a few degrees outside of the optical axis so that the observer's head does not intercept the light entering the telescope.

Because of the great focal length as compared with the aperture, there is no perceptible distortion of the image. The Herschelian type of mounting dispenses with the use of prisms or diagonal mirror, although it has other drawbacks.

The total cost of the telescope, exclusive of the finder, was less than ten dollars, according to Mr. Hayden, who is now working on a twelve-inch Cassegrainian type of telescope with 52-inch focal length. This instrument will have a fixed equatorial mounting, with a shelter, which will make it more expensive.

* * *

Whistling Backwards, an Example of Railroad Conservatism

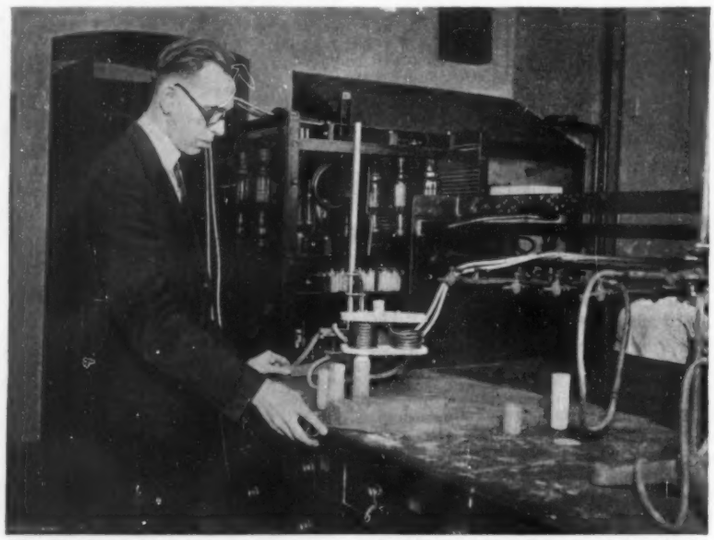
WHERE should a locomotive whistle be placed? Why are the whistles of locomotives customarily placed directly behind the steam dome, the sand box, the bell and the stack, cutting off most of the sound which should be thrown ahead of the engine instead of out to the side and behind it? The whistle, says Professor Foley, Head of the Department of Physics at the University of Indiana, writing in *Railway Age* (New York), should be placed directly on the front of the locomotive and should be provided with a sound reflector so that the warning signal will be thrown strongly in advance where it can be heard by motorists seated within closed cars.

Doubtless, when locomotives first began to be common, nearly a century ago, the matter of placing the whistle on the locomotive was of trifling moment. There were then few competing noises. Today the motor car has changed the situation. The locomotive whistle is now important as a warning. Yet such is the conservatism of railroad men that the obviously detrimental habit of placing the whistle in the wrong place has lived on for decades.

Professor Foley estimates that it is costing us the price of 4,000,000 tons of coal yearly to blow whistles which could be blown to better advantage and with far less expenditure of energy if the whistles were not masked and muffled by the various obstructions mentioned above. He says that "the location of a locomotive whistle is usually about as bad as if it were placed inside the cab or under the locomotive itself."

Bearing quite directly on this situation is the fact that for many months the railway journals have contained a running discussion of the lack of college trained men with new ideas and a fresh point of view, in the railroading profession. The college man, unlike the present-day railroad man, has not been brought up for years in a circle whose traditions are so strong that they tend to crush out originality. At the present time extremely few railroad executives are college men, and even if the railroads are beginning to discover their lack in this respect, the young college graduate with few exceptions has proved unwilling to enter the organization of the average railroad company because he feels that nearly every hand will be set against him. Men who have slowly worked their way up from yard foreman to superintendent or from telegraph operator to president do not as a rule take kindly to the college man. They feel that he does not know what they call "good railroading," which is to be learned only by about forty years of actual experience on the railroads. So the whistle, along with many other similar details of the railroad world, still remains where it has always been.

With his new whistles and reflectors, Professor Foley conducted some interesting tests. He took a locomotive, placed it on a turn-table, put a man in the cab to blow the whistle, and then drove in a closed car to a distance of 1,200 feet, stopped the car but not the motor and listened whenever the whistle was blown. From time to time the locomotive was turned further around on its turn-table, thus simulating the average conditions of audibility of a whistle all around the horizon. He found that the sound of the whistle is nearly three times as intense on either side of the locomotive as it is ahead, where it ought to be loudest. He proposes not only to remove the whistle to the very front of the engine, but to place it in a simple sound reflector like a bowl. As the second diagram shows, the audibility would then become four times as great in front as in the rear. "Even a mule knows that sound can be reflected," says the Professor, "for the mule turns his ears in the direction from which the sound comes."



The Northrup high-frequency furnace at the United States Bureau of Standards

We reproduce from Professor Foley's article a diagram showing the relative intensity (dotted line) of sound all round the horizon from a locomotive having its whistle placed in the usual position; also a diagram showing the relative intensity when the whistle is placed on the head of the engine and in a reflector. It will be noted that in the first diagram, showing the present conditions, the sound is actually *stronger behind the locomotive than in front of it*, and two or three times as intense at right angles to the track as along the track.

To make matters worse, when the locomotive is running (as it was not in these tests) the exhaust steam and smoke and hot convection currents from the boiler are swept back over the locomotive, absorbing much of the energy of the whistle. "If anyone doubts this statement," asserts the Professor, "let him stand on one side of a bonfire and talk to someone on the other side. He may fail to make himself heard at all." This is due to the fact that a part of the energy of a sound wave is reflected when it falls upon a stream of hot gases.

Benjamin Franklin's homily about "paying too much for the whistle" becomes apposite when we read that a locomotive whistling two minutes out of each hour thus consumes 30 extra pounds of coal and 275 pounds of water hourly. The smaller but correctly located whistle advocated by Professor Foley would consume much less if given a chance to work at its best advantage.

Some railroad men have already objected to Professor Foley's plan, stating that the whistle is not merely a warning to motorists, but is a signal which must also be heard by the brakeman at the rear of the train. Yet the two diagrams show that with the whistle placed in front of the stack and within a reflector there would still be as great audibility behind the train as there now is in front.

Thus for nearly a century the railroads have been whistling backwards.

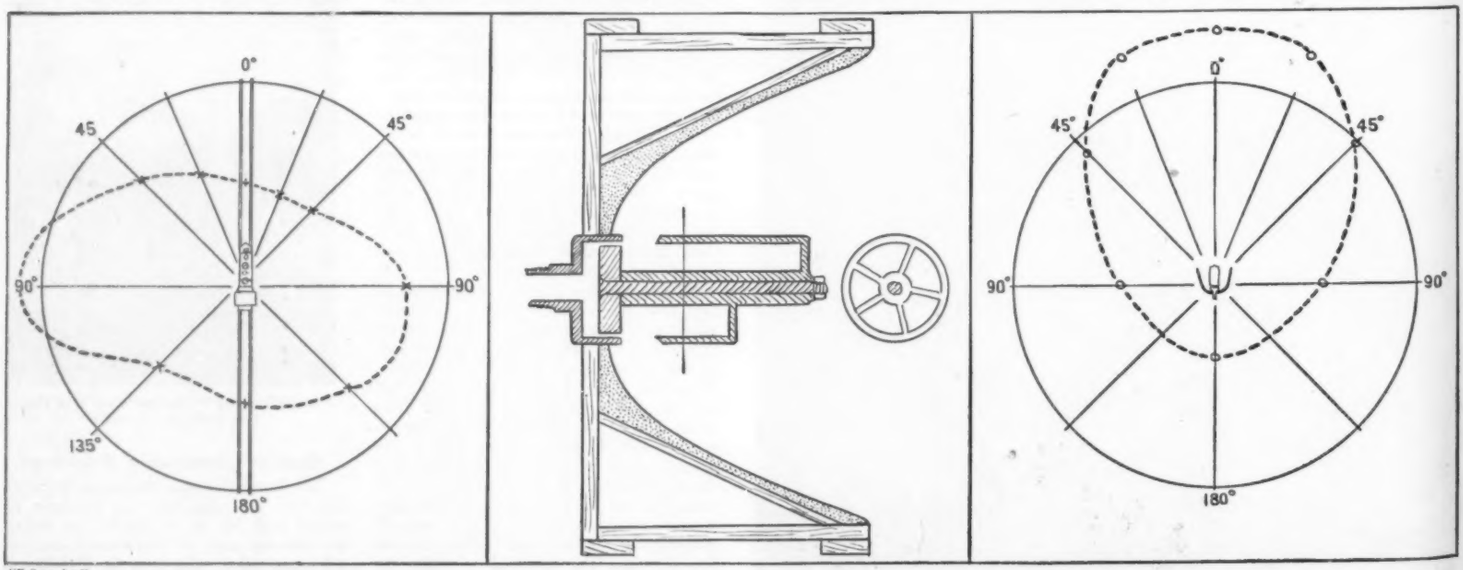
* * *

Radio-Operated Furnace Melts Precious Metals

A NEW 1½-kilowatt radio-operated furnace for melting platinum and other metals has just been installed in the Metallurgical Division of the United States Bureau of Standards at Washington, according to a short article furnished by S. R. Winters. The vacuum tubes used in this apparatus are identical in shape, size and characteristics with many of the electron tubes found at any radio broadcasting station. Six 250-watt transmitting electron tubes are employed. The 110-volt, 60-cycle electric house-lighting system is the sole source of power, no motor generator, batteries or other current supply being required.

The purpose of this high-frequency converter is to change the 60-cycle electric-lighting current into one of high frequency —on the order of 300,000 cycles per second. This frequency or wavelength is employed to raise heat for the melting of platinum, gold, or other precious metals, instead of being used as a medium for radio signaling. In the production of pure platinum, for example, this type of furnace is peculiarly fitted, and little difficulty is experienced in reaching a heat of 3,000 degrees Centigrade (5,430 degrees, Fahrenheit).

This variety of furnace, the invention of Dr. Edwin F. Northrup of Princeton University, is capable of heating with marked rapidity. A crucible filled with graphite can



"Railway Age"

Left: **The curve of sound intensity surrounding a locomotive whistle mounted according to the present custom. The locomotive is shown in the circle.** ***Center:*** **Sections of a chime whistle mounted in the advocated sound reflector.** ***Right:*** **The effect of a sound reflector. The dotted curve shows where the sound is heard best**

be subjected to a temperature of 4,500 degrees, Fahrenheit, in less than 20 minutes. Yet, with this degree of heat on the inside of a steel furnace, the temperature on the outside is not likely to exceed 212 degrees, Fahrenheit, a condition contributing to the operator's comfort, especially during the summer months. The capacity of a powerful furnace of this type—for example, when operated by a 20-kilowatt, high-frequency converter,—is suggested by its achievement of melting 85 pounds of copper per hour, or between 500 and 700 pounds of this metal in the course of eight hours.

The Northrup high-frequency furnace works on the principle of a transformer in which the primary is a conductor, in the form of a coil of copper wire or tubing, and the secondary is a mass of conducting material within the coil. The current within the primary coil does not heat up much above room temperature, the coil being water cooled, but the mass within it, forming its secondary, is rapidly heated to a high degree. Thus, this type of furnace should be thought of as a transformer in which, instead of attempting to reduce heating effects to a minimum, as is the case with the ordinary transformer, these effects are exploited as fully as possible. As a transformer it would be highly inefficient. Regarded as a heating furnace it is highly efficient and effective.

The high-frequency converter sometimes produces interference with the reception of radio communications. The amount of disturbance caused by this radio-operated furnace is a disputed question, some claiming that it is considerable, while others maintain that it is a negligible quantity.

Strange to say, this same furnace may be employed for increasing the efficiency of the vacuum tubes used in radio receiving sets. Quite recently, in fact, licenses were issued by the Government to the General Electric Company, the Western Electric Company and to the Westinghouse Electric and Manufacturing Company, permitting them to manufacture high-frequency apparatus for heating the interior parts of vacuum tubes while gases are being expelled. Gases in the metal parts of such tubes are said to be more readily driven off by the induction method just described than by applying heat to them during evacuation—the former method.

The converter, which transforms the 60-cycle electric current into high frequencies, is enclosed in a metal cage. On its face is a switchboard, containing a wheel for controlling the electric power and indicating wattmeter. The three essential units of this converter are enclosed in the cage. These are: the condensers, a transformer, and a discharge gap. The latter has two electrodes which are raised and lowered over a surface of mercury held in a metal container. A hand wheel on the face of the switchboard is manipulated for raising and lowering the electrodes. The power delivered by this converter may be varied from zero to many kilowatts by changing the distance of these electrodes above the surface of the mercury. The transformer steps the line voltage up to 6,000 volts.

* * *

Fat Sweet Potatoes

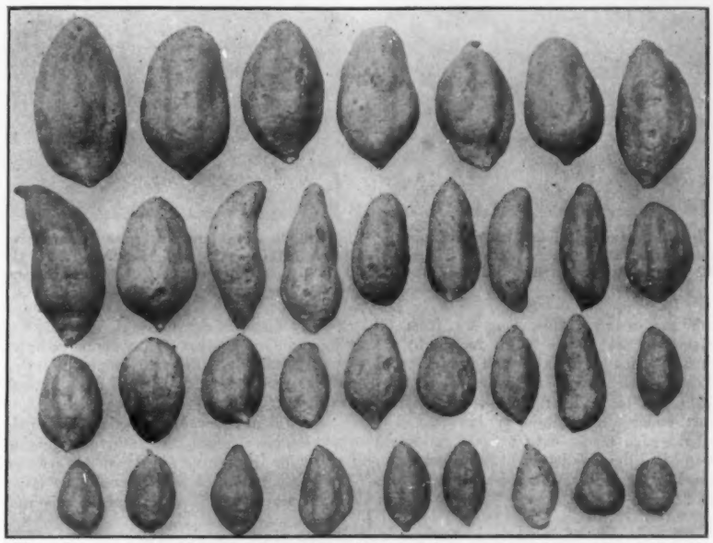
CONTRARY to popular belief, the day of chance discoveries is not entirely past. Perhaps the latest case is that of controlling the shape of sweet potatoes by using certain fertilizing elements.

In 1921, while digging sweet potatoes to measure the influence of different amounts and kinds of fertilizers on yields, L. G. Schermerhorn of the New Jersey Agricultural Experiment Station observed a marked difference in the shape of tubers coming from the various plots on which they were being grown. Schermerhorn at once followed the clue which pointed to fertilizer influence.

This was a rather startling discovery, since both growers and scientists have always considered such variations a natural phenomenon beyond human control, like the shape of leaves or the color of an animal's eye.

Four years of subsequent tests finally proved that potash will influence the shape of sweet potatoes. A fertilizer containing but a small percentage of potash produces a large number of spindly tubers. Within limits, increasing the amount of potash increases the number of chunky tubers. The common commercial fertilizer containing 3 units of nitrogen, 8 units of phosphoric acid and 8 units of potash, and known to the trade as a "3-8-8," was found to be the most economical from the standpoint of producing the most chunky tubers at the least cost. In other states than New Jersey, where the experimental work was done, differences in soil and climate may require a slightly different proportion of potash.

What this discovery will mean to sweet potato growers in guiding their use of fertilizers may be seen in the average results obtained in Schermerhorn's tests. Fertilizers with no potash gave such a large percentage of spindly tubers that only 100 bushels an acre were marketable. The same quantity of a 3-8-8, with its 8 per cent of potash, gave 152 bushels per acre—a 52 percent increase.



The plot treated with a fertilizer containing eight percent of potash produced these desirably-shaped potatoes

This discovery, if made use of by the larger sweet potato growers, will mean to them a saving of hundreds of thousands of dollars a year.

* * *

A Warning to Amateur Telescope Makers

IN the Scientific American book, "Amateur Telescope Making," pages 15 and 19, the telescope maker was advised to coat his mirror, after silvering it, with a lacquer diluted six to one with amyl acetate. In certain cases, lacquer diluted at the ratio of only two to one has been supplied. The latter ratio of dilution is that which is nearly always used when this lacquer is applied to silverware, but it is too thick for telescope mirrors.

The manufacturer of the lacquer was visited and, when fully acquainted with the peculiar requirement, stated in a very friendly manner that since so great a dilution was very unusual it was possible that the thicker lacquer had been sent to our telescope makers in some cases by well-intentioned employees. It should be obvious, however, to anyone that these manufacturers have displayed considerable patience, and a desire to aid science, in filling hundreds of small, one-dollar orders requiring special packing, and so on, since they ordinarily deal in much greater quantities of lacquer.

To enable the telescope maker to decide whether or not his lacquer is sufficiently diluted, the writer made a small experiment, with the following results: Lacquer diluted at two to one is almost as thick, in the can, as olive oil. It flows in an almost unbroken stream from a small stick and when poured over a test piece of glass it runs down quite deliberately. Lacquer diluted six or eight to one is nearly as thin as water, drops from a stick by drops and quickly runs down a pane of glass. If found in two to one dilution an ounce of amyl acetate may be obtained from the drug store for a few cents and the proper dilution made.

Several amateurs have expressed fear that lacquer will injure the optical qualities of their mirrors. This method of protecting them is not, however, a novelty. It was first tried at the Paris Observatory and, according to Bell, in his excellent book, "The Telescope," (McGraw-Hill Book Co.), it has been in use since 1913 at the Harvard Observatory, particularly on the 24-inch reflector. R. W. Porter has also used it for years and confirms the authorities mentioned above. However, Bell emphasizes strongly that it must not be used too thick. He recommends a six to one, or even an eight to one, dilution.

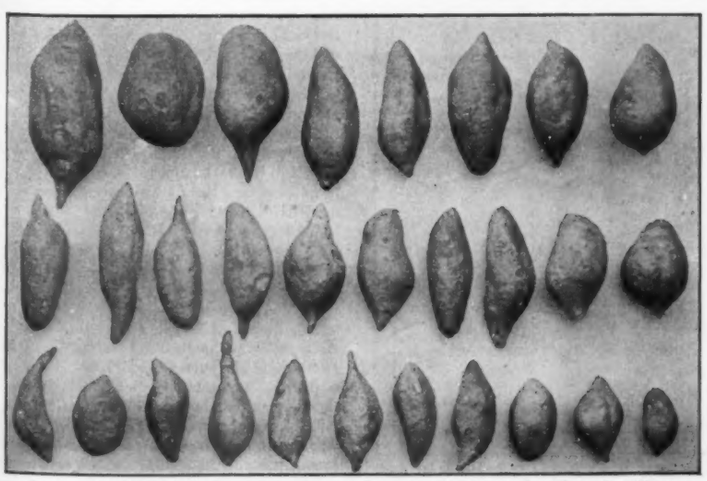
Inquiries received indicate the advisability of issuing another warning. In making the Foucault test, the lamp should remain stationary. If moved with the knife-edge, the formula used (page 62, "Amateur Telescope Making") will bring about a serious case of over-correction of the mirror, doubling the desired correction, unless changed to r^2 over 2R.

* * *

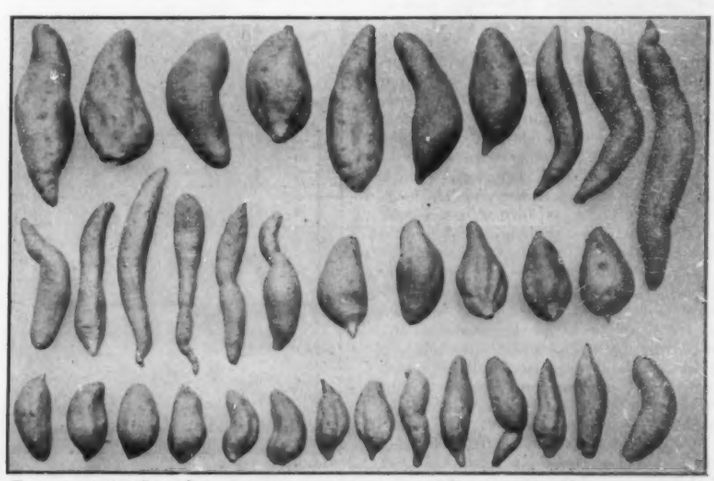
Most Powerful Narrow Gage Locomotive in Existence

THE engineers who located our western railroads, through the Rockies and the Cascade Mountains, found themselves confronted at times with a bewildering task. If the roads were to handle the heavy passenger and freight trains which would be required as the country developed, it was necessary to keep the grades down below certain limits. Hence, in crossing the mountains, the engineer, in order to develop his line with reasonable grades, frequently had to gain distance by swinging his line to and fro up the mountainside until, when he had reached the top, the distance traversed by his located line, in extreme cases, would be many times as great as the distance measured in an airline from valley to summit.

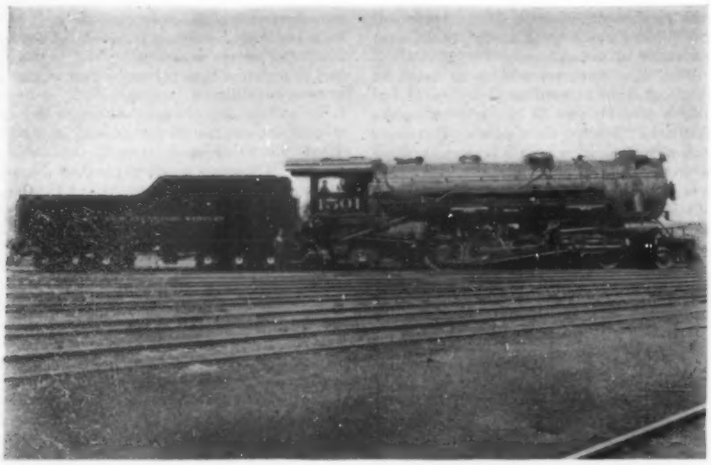
Nowhere was more difficult mountain country encountered than in the territory covered by the lines of the Denver & Rio Grande Western Railway. So costly was the construction that it was decided to reduce the gage from 4 feet 8½ inches to 3 feet. For many years, the system remained



A representative lot of sweet potatoes from a plot treated with a fertilizer containing six percent of potash



Representative lot of sweet potatoes grown on a plot treated with a non-potash fertilizer. Many of the tubers are spindly



Broad-gage mountain locomotive used on the mountain division of the Denver and Rio Grande Western Railroad. Weight, engine and tender, loaded, 644,600 pounds; cylinders, 28 inches by 30 inches; horsepower, 3,300

The heaviest narrow-gage locomotive. Built for hauling trains over severe mountain grades of the D. and R. G. Western Railroad. Total weight, loaded, 286,600 pounds; cylinders, 20 inches by 24 inches; horsepower, 1,410

narrow gage; but gradually, as traffic increased, the lines have been changed from narrow to broad gage, until only certain sections of the 3-foot gage system are now in operation.

We show a profile of a portion of the narrow-gage line on the route from Denver to Durango, commencing at Alamosa and extending to Arboles. It will be seen that not only are the grades heavy—the maximum varying on certain stretches of the line from 1.42 percent to 4 percent—but the curvature of the line is also extremely severe—the maximum varying from curves of 10 degrees to as high as 20 degrees. We direct particular attention to the section of line between Chama and the summit at Cumbres, where there is a grade of 4 percent and the maximum curves are 20 degrees. Moreover, the whole amount of curvature is 3,523 degrees, or nearly ten complete circles.

The great difficulty of operating freight and passenger trains over lines with heavy grades and curvature will be understood from the fact that the principal roads of the country have spent hundreds of millions of dollars during the past twenty-five years in taking the curvature out of their lines and in cutting down the grades, so that on some systems a grade of 1.5 percent and 5 degree curves are the maximum. So difficult is the country through which this narrow-gage line runs, that any such reduction of curvature and grades would be prohibitive, not only because of physical difficulties but because of the cost.

We present illustrations of the two latest and most powerful locomotives which are operating trains over the mountain divisions of the Denver & Rio Grande—the one being used for narrow-gage operation and the other on the broad-gage lines. The narrow-gage locomotive is the most powerful of its kind in existence, and it is really remarkable that so much weight and power could be assembled in an engine capable of operating on track only 3 feet wide, especially when we remember that it has to run around curves of as high as 20 degrees. The secret of its stability lies in the fact that, in spite of the height and bulk of the locomotive, its center of gravity, because of the great weight of cylinders, frames, wheels and driving gear, lies very low down. Moreover, stability is further assured by giving a high super-elevation of several inches to the outside rail of the curves.

The total weight of the engine and tender loaded is 286,600 pounds. How great is the increase in weight and power of a broad-gage engine due to the larger dimensions, is seen by a comparison of this narrow-gage locomotive with the latest broad-gage locomotive built for mountain service, for the whole weight of the engine and tender loaded is 644,600 pounds.

We present herewith in parallel columns the principal items of the two locomotives. It will be seen that in the broad-gage type the cylinder dimensions, as compared with the narrow-gage, have gone up from 20 inches by 24 inches to 28 inches by 30 inches; that the length over all has increased from 67½ feet to 95 feet; the height from 13½ feet to 16 feet; and the width from just under 10 feet to over 11 feet. The narrow-gage tender carries 5,000 gallons of water and the broad-gage 14,000 gallons, and the load of coal has increased from 8 tons to 22 tons.

Comparison Narrow and Broad Gage Locomotive
Denver & Rio Grande Western Railroad

	NARROW GAGE	BROAD GAGE
Cylinders	20 ins. Diam.; 24-in. Stroke	28 ins. Diam.; 30-in. Stroke
Driving Wheel	44 ins. Diam.	63 ins. Diam.
Boiler Pressure	195 lbs. per sq. in.	210 lbs. per sq. in.
Length Over All	67 ft. 5⅜ ins.	95 ft.
Height	13 ft. 4 ins.	16 ft.
Width Over All	10 ft.	11 ft. 2½ ins.
Weight on Drivers	143,850 lbs.	257,500 lbs.
Total Weight of Engine	187,100 lbs.	377,000 lbs.
Engine and Tender Loaded	286,600 lbs.	644,600 lbs.
Capacity of Tender	5,000 gals. Water 8 tons Coal	14,000 gals. Water 22 tons Coal
Horsepower of Boiler	1,410	3,300

"Hooch," "Home Brew" and Copper

SUCH is the title under which the *Journal of the American Medical Association* (Chicago) points out that copper should not be employed where it may come in contact with foods or drinks, especially if they contain acids of any sort. Copper, it is stated, is readily dissolved by many of them and is liable to bring about the symptom complex known under the different names of hemochromatosis, bronzed diabetes and pigment cirrhosis.

As a consequence of modern economic and social changes, the latent dangers of poisoning from certain heavy metals are now suddenly presented to the public at large. Gasoline, says this noted medical journal in an editorial, brought about nation-wide concern about lead. Suicides and syphilis awakened a new interest in mercury. And now the bootlegger brings copper to our toxicologic attention.

As medical authorities point out, the fact that our organs on chemical examination show a certain amount of copper, does not mean that we are all suffering from copper poisoning, for it seems that we can handle five to ten one-thousandths of a gram of copper per day. If, however, the amount absorbed exceeds a certain definite limit, the danger of pigmentation of the liver and pancreas is evident. Chemists have demonstrated that present-day distilled liquors may contain as much as 173 one-thousandths of a gram of copper per quart, while samples of "home brew" have been found to show the presence of 23 one-thousandths of a gram per quart.

It is pointed out that the introduction of the copper into the drink is due to the action of organic acids in the mash, distilling over with the alcohol and acting on the worm of the condenser, when it is made of copper. Cocktail shakers of copper or brass, lined with silver or tin, come in for part of the incrimination. When the plating of these receptacles wears off or dissolves, the acids readily attack the copper. But on the shoulders of the "old Demon Rum" about which sentimentalists have raved for centuries, does not fall all of the medical journal's obloquy. It is pointed out that lemonade containing acids is usually shaken in copper shakers at soda fountains, and that copper pots and kettles also find use in the kitchen.

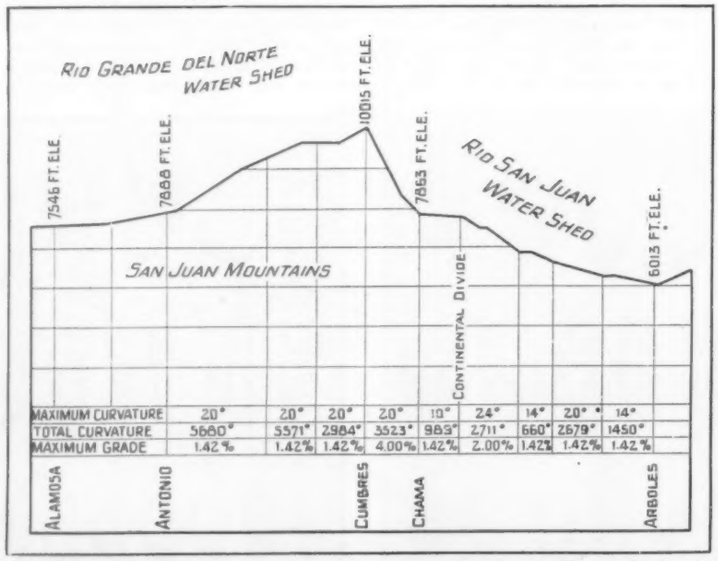
The advice of the medical authorities who warn us about these dangers, seem wholesome, says the medical journal, and continues; "copper should not be employed where it may come in contact with foods or drinks, especially if they contain acids of any sort, because it is readily dissolved by many of them."

* * *

Not A Buried Treasure Finder

IN the December 1925 issue of the Scientific American, we published a brief, nontechnical summary and critique of the several methods of prospecting from above ground, for ores, oil and so on. One of the methods mentioned was that which employs the torsion or gravity balance. This instrument determines slight variations in the density of the rocks beneath the surface, and in that manner it has proved to be of great assistance in locating large, valuable deposits of mineral and oil.

We have now received for review a brief treatise entitled, "The Eötvös Torsion Balance," published by one of the manufacturers of these delicate instruments, L. Oertling, Ltd., London, England. This work of about 100 pages describes the instrument, the method of observing, the planning of the survey, and so on. To quite a degree, it is mathematical. The use of the torsion balance requires training, not only in higher mathematics, but in geology. The instrument costs several thousand dollars. It is now in regular use, especially by the large oil companies, but it does *not* locate "buried treasure."


RIO GRANDE DEL NORTE WATER SHED
7546 FT. ELE.
7888 FT. ELE.
10015 FT. ELE.
7863 FT. ELE.
RIO SAN JUAN WATER SHED
6013 FT. ELE.
SAN JUAN MOUNTAINS
CONTINENTAL DIVIDE
MAXIMUM CURVATURE 20° 20° 20° 20° 10° 24° 14° 20° 14°
TOTAL CURVATURE 5660° 5571° 2984° 3523° 985° 2711° 660° 2679° 1450°
MAXIMUM GRADE 1.42% 1.42% 1.42% 4.00% 1.42% 2.00% 1.42% 1.42% 1.42%
ALAMOSA
ANTONIO
CUMBRES
CHAMA
ARBOLES

Profile of difficult narrow-gage line of Denver and Rio Grande Western Railroad across the mountain divide where the grades reach four percent and the curves run as high as 20 and 24 degrees

Would you?

YOU know how brothers and sisters argue about things.

Well, here was a case where the boy was much put out because his sister would not accept the attentions of his best friend, or go out with him.

She simply refused flatly and he could never find out why.

"You wouldn't either," she said, "if you knew what I know."

* * *

You, yourself, rarely know when you have halitosis (unpleasant breath). That's the insidious thing about it. And even your closest friends won't tell you.

Sometimes, of course, halitosis comes from some deep-seated organic disorder that requires professional advice. But usually—and fortunately—halitosis is only a local condition that yields to the regular use of Listerine as a mouth wash and gargle. **It puts you on the safe and polite side. Moreover, in using Listerine to combat halitosis, you are quite sure to avoid sore throat and those more serious illnesses that start with throat infections.**

Listerine halts food fermentation in the mouth and leaves the breath sweet, fresh and clean. *Not* by substituting some other odor but by really removing the old one. The Listerine odor itself quickly disappears.

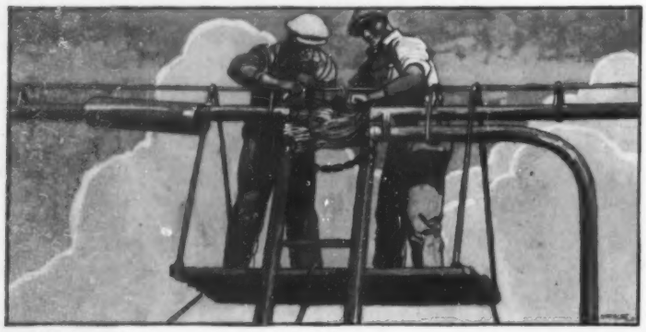
This safe and long-trusted antiseptic has dozens of different uses; note the little circular that comes with every bottle. Your druggist sells Listerine in the original brown package only—*never in bulk.* There are four sizes: 14 ounce, 7 ounce, 3 ounce and 1¼ ounce. Buy the large size for economy.—*Lambert Pharmacal Company, Saint Louis, U. S. A.*

For HALITOSIS use LISTERINE

A Challenge

We'll make a little wager with you that if you try one tube of Listerine Tooth Paste, you'll come back for more. LARGE TUBE—25 CENTS

Joining the wires in a great trunk nerve between New York and Chicago



The Nerves of a Nation

THE magnitude of our present system of telephone communication was beyond the thoughts of men fifty years ago. While at that time Bell, the inventor, had a prophetic vision of places and houses and factories connected by telephone, even he could not have foreseen the American city of skyscrapers with more telephones in one building than are to be found in many a foreign country.

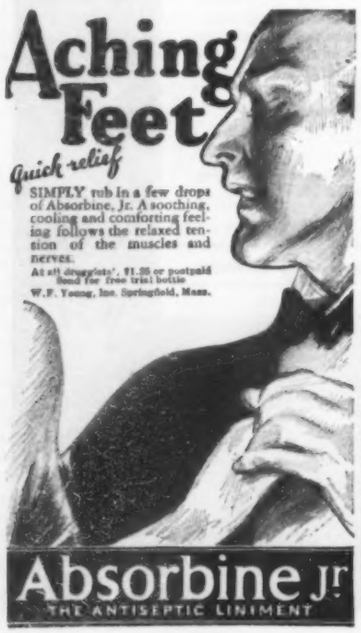
The massed multitudes of the modern city can no longer be served by wires strung in the air. We now have telephone cables no bigger than a man's wrist each containing 2400 thread-like wires, carrying beneath the city streets their millions of spoken messages. Long distance cables overhead and underground connect cities with one another by storm-proof conductors, now being extended into a country-wide network.

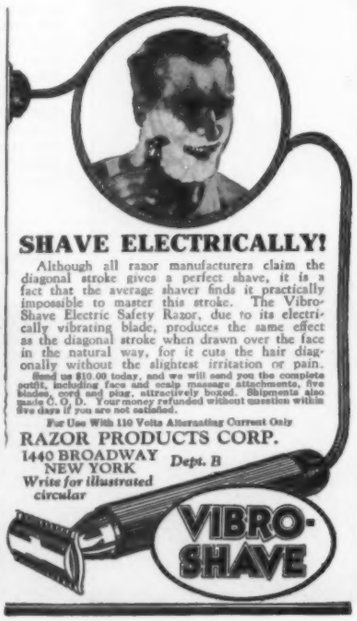
At the present time nine-tenths of the 45,000,000 miles of telephone wire in the Bell System are in cable. The service of each telephone user has become more and more reliable with the extension of this cable construction.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION


Aching Feet
Quick relief
SIMPLY rub in a few drops of Absorbine, Jr. A soothing, cooling and comforting feeling follows the relaxed tension of the muscles and nerves.
At all druggists', $1.25 or postpaid. Send for free trial bottle
W.F. Young, Inc. Springfield, Mass.
Absorbine Jr
THE ANTISEPTIC LINIMENT


SHAVE ELECTRICALLY!
Although all razor manufacturers claim the diagonal stroke gives a perfect shave, it is a fact that the average shaver finds it practically impossible to master this stroke. The Vibro-Shave Electric Safety Razor, due to its electrically vibrating blade, produces the same effect as the diagonal stroke when drawn over the face in the natural way, for it cuts the hair diagonally without the slightest irritation or pain.
Send us $10.00 today, and we will send you the complete outfit, including face and scalp massage attachments, five blades, cord and plug, attractively boxed. Shipments also made C. O. D. Your money refunded without question within five days if you are not satisfied.
For Use With 110 Volts Alternating Current Only
RAZOR PRODUCTS CORP.
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Write for illustrated circular
VIBRO-SHAVE

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Herbert Photos

A modern ship's radio receiver. Square bakelite jackets protect the coils of the S.S. *Hamburg's* receiving set. Note the flexible wooden washers which insulate the high-frequency wires used for plugging into the jacks on the panel behind the operator. Each jack corresponds to a different wavelength to which the transmitter can be tuned

Television Near Says Engineer

TELEVISION is within the grasp of research engineers and before a period of five years has passed, it will be possible to equip transmitting and receiving stations so that listeners can see what is transpiring before the microphone, according to Harry Sadenwater, chief engineer of stations WGY, KOA and KGO.

"But I do not believe we want to do both television and radio telephony simultaneously," Mr. Sadenwater told the Radio Club of America. "If a story is skilfully told or a musical program is skilfully presented, the entire performance is much more beautiful if the actual scenes and the appearance of the artists are left to the imagination, so the listener can form his own pleasing picture of the heroine and the most villainous-looking scoundrel, and not have the opposite types appear because the personalities were best suited by voice characteristics for a particular part."

Receiving Licenses for Bay City

AN ordinance to regulate the operation of radio receivers has been passed by Bay City, Michigan. It provides that no citizen can operate a receiver without a license, the fee for which is two dollars. Violations are punishable by a fine of not in excess of one hundred dollars and imprisonment for three months or either. A third violation brings about a revocation of the license.

Weather and Fading

HERTZIAN wave propagation tests conducted by the General Electric Company at Schenectady, New York, with the cooperation of radio fans in various sections of the United States, revealed that barometric pressure and weather have only a minor influence upon broadcasting. However, the data show that signals received at short distances are stronger when they have come through a region of even pressure, than when they have traveled from a high to a low pressure area or vice versa. At distances of more than 400 miles the conditions along the surface of the earth seem to have little if any effect.

In connection with the weather tests, observations were made on fading, and it was found that there is a change in conditions from January to February. In the study of January reports, it was discovered that most of the bad fading was found in a definite region between 200 and 400 miles from the transmitter. The February reports indicated that equally bad fading occurred at all distances beyond 200 miles and was not confined to any particular zone. Ten percent of the reports record bad fading; 35 percent slight fading and 55 percent no fading.

It seems that radio reception everywhere is poorer in February than in January and the engineers believe this due to some change in the upper atmosphere rather than a change in weather conditions along the surface of the earth.

Split-Wave Theory

DATA secured and compiled by the engineers at WGY prove the theory that radio waves split into a ground and sky wave in passage from a transmitter to a receiver. According to the split-wave theory, one wave passes along the ground and the other travels 100 miles or so above the surface of the earth where it is reflected back by a semi-conducting surface in the upper atmosphere. The ground wave weakens rapidly and becomes negligible about 200 miles from the broadcasting station. Reception at greater distances is due entirely to the sky wave.

Exclusive Radio Shop Doomed Says Retailer

EXCLUSIVE radio stores will be a thing of the past within a year or two is the opinion of J. W. Griffin, President of one of New York's largest exclusive radio retail organizations.

In an address before the Radio Manufacturers' Association, he said, "This is true because during the last three years the seasonal nature of radio has become more and more marked. The season has become shorter at both ends, and the break between the months of good business and bad business more and more sharply defined. The radio business as a business probably begins about Columbus Day, October 12, and it is pretty nearly all finished by St. Patrick's Day, March 17.

"Enough business may be gained during these few months to show a small profit for the year," said Mr. Griffin, "if added to the small sales that may be eked out of portable sets and accessories during the summer. But this is an immense waste of space facilities and energy during the summer, which should certainly be applied to some good purpose."

Mr. Griffin said that the successful dealers of the future will handle some other lines of merchandise, which will find a demand from March to October.

WEAF Incorporated

STATION WEAF and the radio broadcasting activities of the American Telephone and Telegraph Company are now known as "The Broadcasting Company of America." The reason for the incorporation, it was announced, is that the radio problems differ from those of regular telephone operation and can therefore be more effectively handled by a separate organization.

Radio-Compass Bearings Free in United States

THE United States radio-compass stations furnish bearings to mariners free of charge. The British charge $1.25 a bearing; France, $1.20 and Sweden, $1.30. The United States Navy compass stations furnished 126,606 bearings during the last fiscal year.

May Discontinue Standard Tests

THE Bureau of Standards is considering the termination of the broadcasting of standard frequency signals, partly because of the increasing use of piezo oscillators and the wide availability of reliable testing services at a number of laboratories that do commercial testing of frequency meters. The piezo crystals hold the station on its exact wavelength.

Radio Increases Current Consumption

DEVELOPMENT of radio receivers which dispense with batteries and employ the house lighting current, together with the fact that broadcast entertainment keeps people at home, is resulting in larger consumption of electricity, according to David Sarnoff, Vice-President and General Manager of the Radio Corporation of America.

"The types of broadcast receivers which now operate completely from the lighting circuit require up to 200 watts for their operation," said Mr. Sarnoff. "The numerous power accessories on the market require from seven to fifty watts. It is reasonable to assume that within the next three or five years, by far the larger percentage of broadcast receivers will draw their local source of energy from the lighting socket. It is estimated that the average of such receivers will consume energy at the rate of eight kilowatt-hours a month.

"Radio is keeping the people at home. We have all known in a general way that this has resulted in larger monthly current bills."

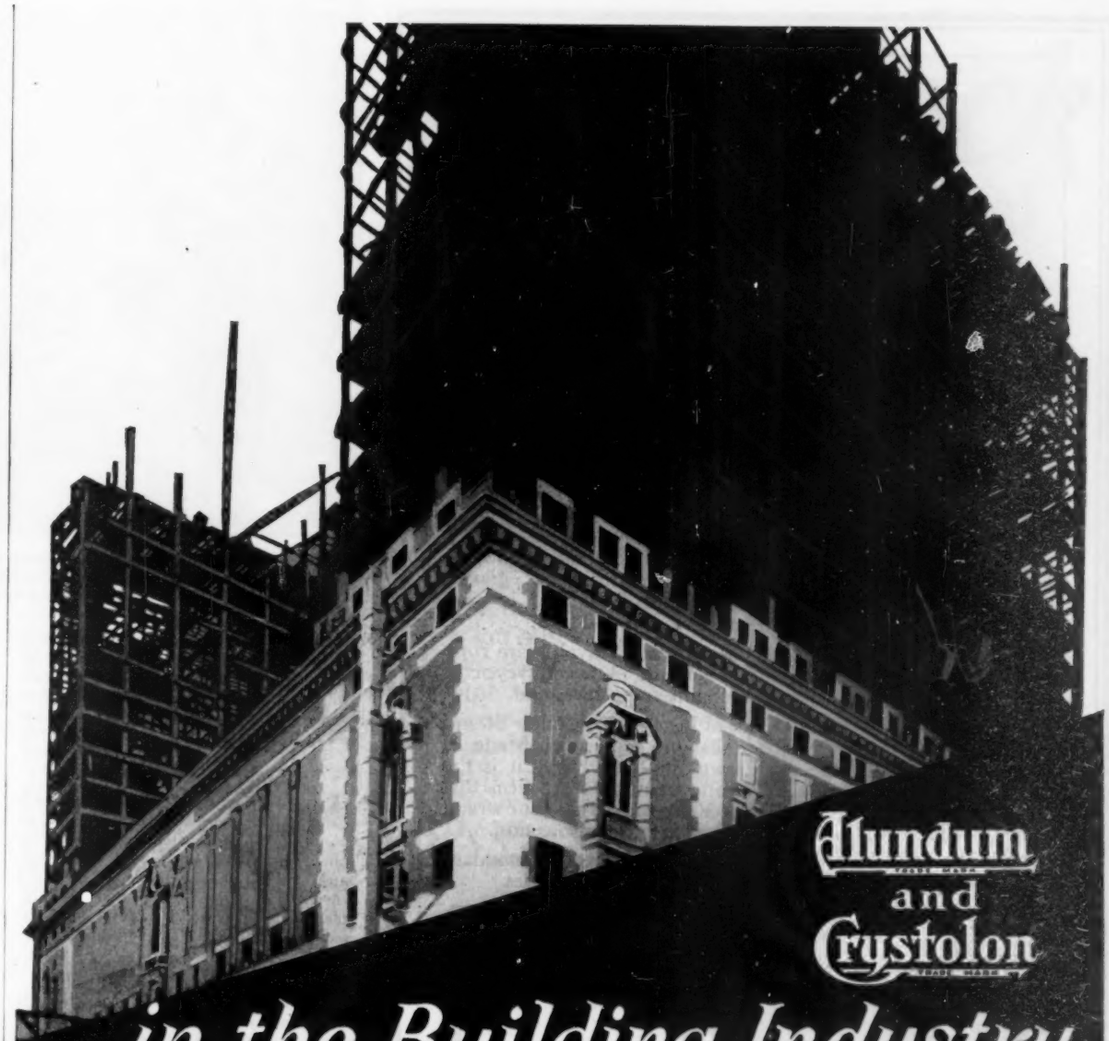
Princeton Station Talked with Hawaii

THE Princeton University Radio Club's 80-meter transmitter has been heard in Toulouse, London, Cape Town and New Zealand, and two-way communication was established on one occasion with an amateur station in Honolulu. The Princeton call is 3 DH.

At the beginning of each college year a call is made for membership in the radio club and all members of the undergraduate body may qualify.

Sun Spots Blamed

VERY few American broadcasting stations were heard in England during the past year compared with the records of other seasons. Foremost among the theories advanced to account for a barrier to American programs in crossing the sea is that sun spots affect



Alundum and Crystolon

in the Building Industry

GRINDING

Grinding plays a vital though unseen part in the building industry. Alundum and Crystolon abrasives, electric furnace materials produced through the medium of the giant hydro electric power plants of Niagara Falls, have a hand in the manufacture of practically every material that enters into modern building.

The structural steel that forms the very backbone of every large structure is fashioned by rolls ground by Alundum grinding wheels.

Marble, granite and the other building stones are coped and surfaced by Crystolon grinding wheels and polished by Alundum abrasive grain.

Lumber is cut, planed and formed by saws and knives kept sharp by Alundum grinding wheels.

Bright hardware and fixtures are buffed and plate glass is bevelled and polished by Alundum or Crystolon abrasive grain.

REFRACTORIES

Alundum and Crystolon abrasives are serving the building industry in the form of refractories. In modern power plants Alundum and Crystolon bricks, plates, blocks and cements give furnace linings that will stand up under the severe firing conditions of present practice.

Steel has its birth in furnaces lined with fused magnesia—another Norton electric furnace product. In the laboratory, the steel is tested and analyzed with the aid of Alundum laboratory ware.

Tile, terra cotta and porcelain sanitary ware are burned in kilns lined with Alundum or Crystolon bricks set up with Alundum cement.

Enameled plumbing ware is baked in kilns lined with Alundum muffles.

NORTON COMPANY
WORCESTER, MASS.

NORTON FLOORS

In the form of Norton Floors Alundum abrasive enters directly into the building itself. Alundum Tiles, Treads and Aggregates have made available to architects a walking surface that is permanently slip-proof and wear-resisting. The various types of Norton Floors make it possible to select one that is suitable for any class of building construction.

There are Alundum Aggregate Tiles and Treads and Alundum Terrazzo for entrances, lobbies, main stairways, elevator landings and other places where appearance is a factor as well as safety and durability.

For service quarters and secondary stairways there are the semi-vitreous Alundum Floor and Stair Tiles.

For washrooms and lavatories and similar places where the small tiles are usually preferred there is Alundum Ceramic Mosaic Tile.

NORTON

Grinding Wheels
Grinding Machines

Refractories-Floor
and Stair Tiles

Hard Work

The giant steam shovel literally gnaws its way into compact earth, sand, gravel, throwing the material behind it with almost human abandon and skill.

In most types of steam shovels, wire rope is the "moving factor"—the conveyor of power from engine to business end.

For all kinds of heavy duty, Yellow Strand Wire Rope has no superior. Made of specially drawn imported wire, it is the pride of a rope manufacturing firm that helped pioneer the industry. One strand is painted yellow for your protection.

This company also makes all standard grades of wire rope for all purposes.

Motorists
Carry a Basline Autowline in your car and safeguard your spare tire with Powersteel Autowlock. Both are made of Yellow Strand. Ask your accessory dealer.

BRODERICK & BASCOM ROPE CO.
843 North First Street, St. Louis, Mo.
Eastern Office and Warehouse: 76 Warren St., New York City
Western Office: Seattle *Factories:* St. Louis and Seattle
Authorized Dealers in all Industrial Localities

Yellow Strand WIRE ROPE

JB450

TELESCOPES
SEND FOR CATALOGUE
W. & D. MOGEY
PLAINFIELD, N. J.

Experimental and Model Work
Fine Instruments and Fine Machinery, Inventions Developed.
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, Inc. 187 Lafayette St., New York City

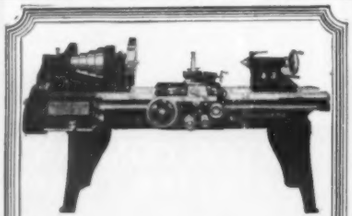
BOILER PRESERVER
"UNISOL" chemically perfect feed-water treatment. Our new pamphlet on correct methods of treatment should be read by everyone interested in steam plants. Mailed on request.
Unisol Mfg. Co. Jersey City, N. J., U. S. A.

MALLEABLE CASTINGS

Rough or Machined

We specialize on machined malleables in quantity production. Many users who operate large machine shops in connection with their business find it to their advantage to buy of us. Perhaps you could do likewise.

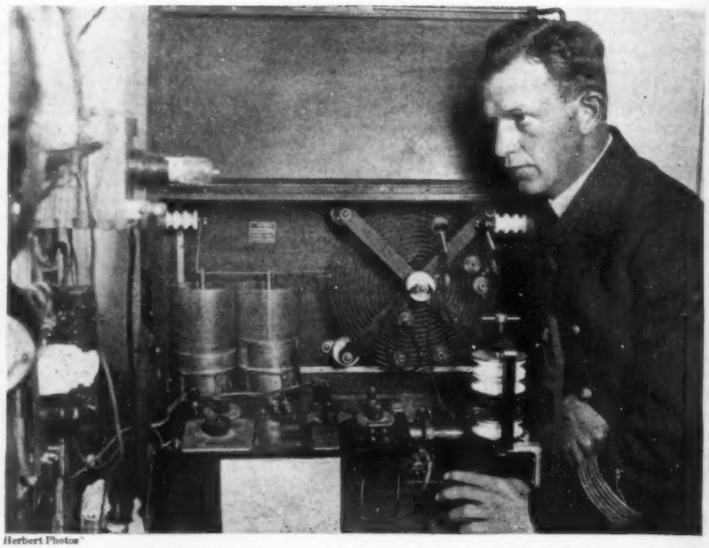
BENTON HARBOR MALLEABLE FOUNDRY CO.
Benton Harbor Michigan



The New South Bend LATHE

New Lathe Catalog Free!
Shows 96 styles and sizes from smallest Bench Lathes to Largest Factory Production Size.

The New South Bend Lathe
is heavier, stronger, has greater belt power—equal in accuracy to any lathe built. Write for Free Catalog. Easy Payment Plan if desired.
South Bend Lathe Works
528 E. Madison St., South Bend, Ind.



Herbert Photos

A 500-watt continuous-wave transmitter operating on wavelengths from 300 to 700 meters serves as the voice of the Flettner rotorship *Baden-Baden*. Tuning of the set is accomplished by adjusting the clips on the spiral coil

the transmission. Scientists say that the sun spots cause electrical disturbances in the atmosphere, and they are looking forward with interest to observe the changes in conditions as the next maximum sun spot period approaches in 1928.

Long Distance Goal

A NEW 1,000-watt Western Electric broadcasting plant has been installed at Caracas, Venezuela. It is operated by the Empresa Venezuelana Radiotelephonica. The call letters are AYRE and the wavelength 375 meters. The aerial site is at a high altitude, which is expected to favor long distance transmission.

Standardizing Equipment

STANDARDIZATION of radio equipment is being done by the radio section of the Associated Manufacturers of Electrical Supplies. This section is divided into numerous apparatus groups, each of which devotes its attention to some specific line of instruments, such as receiving sets, tubes and batteries. The various committees develop standards for the instruments with which they are concerned, and when their standards are completed they are submitted to the technical committee of the section, which studies them to make sure that they are consistent with the requirements of the industry.

Up to the present time thirty-one radio standards have been approved and many others including radio symbols for use in diagrams, are nearing completion. It is expected that within a comparatively short time most of the radio equipment will be standardized in this manner. The work however, will undoubtedly continue indefinitely because of the constant development in the science of radio communication.

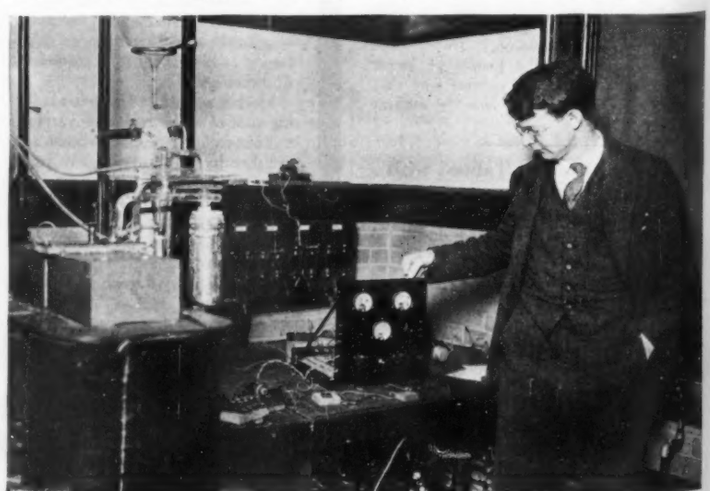
Neutrodyne Uses House Current

A SIX-TUBE neutrodyne circuit designed to operate directly on the alternating current of house lighting mains, dispensing with all batteries has been introduced by the Garod Radio Corporation.

Three dials are employed for tuning as in the case of the standard neutrodyne circuits. Two small knobs are provided to regulate the volume. One of these intensity controls governs a series condenser in the antenna circuit. The function of this is to aid in tuning in the lower wavelengths and to prevent overloading the detector. The other volume regulator is a high-value variable resistance shunted across the secondary of the first audio amplifying transformer.

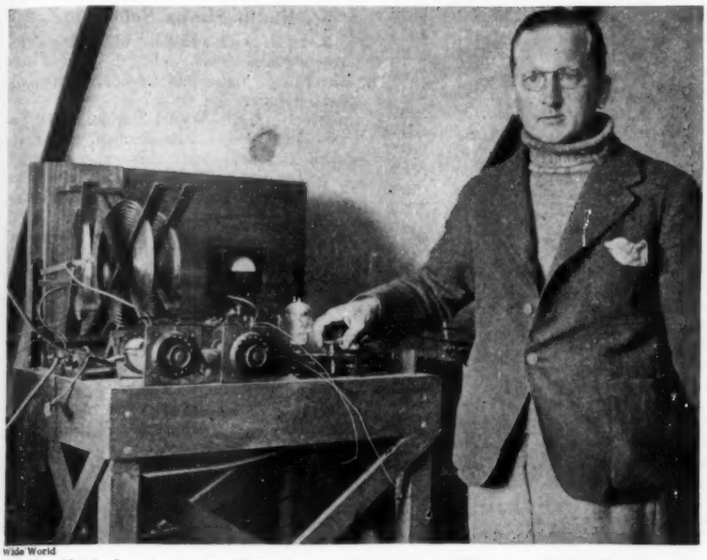
One 216-B vacuum tube serves as the rectifier; three UX-112 tubes act as the first and second radio-frequency amplifiers, and first audio-frequency amplifier. The detector is a UV-199 and the last audio amplifier is a UX-210.

No hum from the alternating current could be noticed in the initial demonstration, and when asked regarding the life of



Harris & Ewing

The apparatus shown here has been designed by the Bureau of Standards for counting the tiny particles of matter by means of a receiving set. The electrons race across a wire and are counted by an adding machine. L. F. Curtiss, an expert on Gamma rays, is shown in the photograph



Wide World

J. D. Chisholm, inventor of a secret radio system. The experimental station is located at Birchington, England. The germ of the invention is said to be the receiving set which picks up the signals straight from the peak of the wave

the tubes. B. F. Miessner, the engineer who designed the receiver, said that less current is consumed by the tubes from the lighting circuit than tubes ordinarily consume from batteries, and for that reason longer life could be expected.

Europe's Stations Are Classified

A NEW plan divides European broadcasting stations into two classes: (1) Every country will receive one wavelength exclusive to itself; but in some cases a country may be given several of these exclusive channels, their needs being adjudged from the standpoint of population, geographical area or educational requirements. (2) Very low power stations, widely separated from each other, will work on exactly the same wavelength, without causing interference, either within the area which they are built to serve or outside that area. Two or more transmitters working on identical wavelengths will be called "common wavelength" stations.

A Trickle Charger

A CHARGER that supplies current into a radio battery just fast enough to compensate for the energy drawn off and supplies that current while the radio set is in operation, has been developed by the General Electric Company. It is known as a trickle charger.

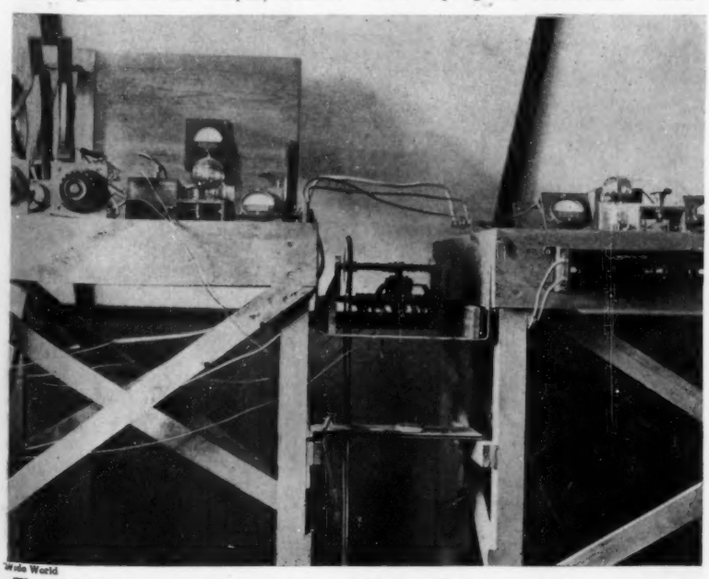
The engineers of the company contend that this device can be used twenty-four hours a day, as it does not disturb reception except on very sensitive sets. If the owner prefers to disconnect the charger during reception, it is merely necessary to pull out the plug which connects the device with the house lighting mains.

The charger has four taps which provide three different low rates and a one-half-ampere boosting rate, so that the exact rate required for any particular receiver can be obtained. The device draws a slight amount of power from the line, only 14 watts being taken from the low tap and even with the boosting rate, the power consumed is but 27 watts.

50-146 Meter Stations

LIST of short wave stations of the United States and Hawaii between 50 and 146 meters.

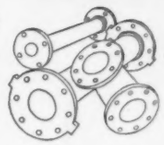
Call	*Station*	*Meters*	*Power*
WBZ	Springfield, Mass....	50	20KW
WQN	Rocky Point, N. Y...	51.5	20KW
KDKA	E. Pittsburgh, Pa....	58.79	20KW
KDC	Casper, Wyo.....	59	500 W
WRB	Miami, Fla.....	68.4	100 W
WRP	Pinecrest, Fla.....	68.g	5 W
WIR	New Br'swick, N. J...	74	20KW
KIO	Kahuku, Oahu.....	90	20KW
KEL	Bolinas, Cal.....	95	20KW
WGH	Tuckerton, N. J.....103		20KW
WOY	Springdale, Pa.....137		100W



Wide World

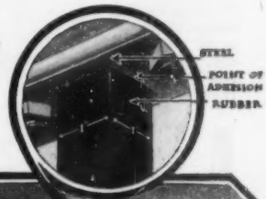
The Chisholm secret radio transmitter. This installation can be heard only with a special receiver. The aerial masts are 100 feet in height

Vulca-lock
Rubber locked *to* Metal



Standard steel pipe lined with Vulca-lock rubber, also elbows, tees, valves and other fittings, for abrasive and corrosive service.

Steel tank cars with Goodrich Vulca-lock rubber lining are in service throughout the country carrying muriatic acid and other corrosives.



IN this test a strip of soft rubber 1 in. square was attached by a butt joint to a steel plate — the only connection between rubber and metal being one square inch of "Vulca-locked" surface. The joint easily supports the weight of two men.

• • •

"Vulca-lock" is a new process of attaching soft rubber to metal — not glued or cemented but "locked" by vulcanization into the "pores" of the metal with a union that is practically integral. No hard rubber bond is necessary.

This opens up innumerable opportunities to combine stability of metal with the corrosive and abrasive resisting properties of soft rubber.

Some of the successful applications are illustrated here. Write us for further information and quotations.

Goodrich Armorite (Vulca-lock process) standard steel sheets with rubber covering of any thickness to resist abrasion. These sheets may be bent, sheared or punched as required for lining chutes, screens, hoppers or any wearing surface.

THE B. F. GOODRICH COMPANY
Established 1870 *Akron, Ohio*

Chutes and launders with Vulca-lock covering, applied in the Goodrich factory.

The Vulca-lock cover on fan blades, rotors and housings protects metal from corrosion and abrasion.

A Process Developed and Perfected by

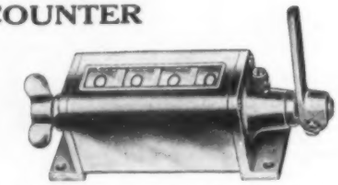
Goodrich

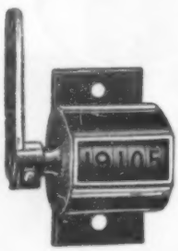
They Can Now Be Equipped with *"Push"*

Even your best machines lack brains; someone has to *push* them. They need a man who's bent on *records* for fast production and fine operating. Be he engineer or machine hand—he's keen to beat his own best record, when running up the production on a

Veeder
COUNTER

The large Set-Back Revolution Counter at right is less than ¼ actual size. The small Revolution Counter below is shown nearly full size.





The Set-Back Revolution Counter above records the output of the larger machines where the revolutions of a shaft record operations or output. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price, with four figures, as illustrated, $10.00 (subject to discount).

The Small Revolution Counter at left records the output of smaller machines where a shaft revolution indicates an operation. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines. Will subtract if run backward. Price, $2.00.

There's a VEEDER to fit every machine—and every need in production-getting. Mechanical and Magnetic Counters—the Veeder booklet shows them all. It's your booklet: write—

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.

DISTINCTION!
Perfect COMFORT!
With ECONOMY!

These three features combined with many other attractions, including excellent meals, form a combination of hotel service difficult to equal.

Make your next stay at the famous

Hotel Alexandria
Los Angeles

RATES
Per Day
single
European Plan

120 rooms with running water $2.50 to $4.00
220 rooms with bath 3.50 to 5.00
160 rooms with bath 6.00 to 8.00
Double, 4.00 up

Also a number of large and beautiful rooms and suites, some in period furnishings with grand piano, fire place and bath, $10 up.

Large and well equipped Sample Rooms

RANCHO GOLF CLUB available to all guests

Please write for booklet

HAROLD E. LATHROP
Manager

WDS	Pottsville, Pa.....137	500W
WLF	Wilsonville, Pa.....137	200W
WBI	Frackville, Pa.....137	200W
WPH	Williamsport, Pa.....137	200W
WCJ	Hazleton, Pa.....137	100W
WHC	Allentown, Pa.....137	200W
WAV	Dearborn, Mich.....140	500W
WDY	Iron M'tain, Mich....140	500W
WGF	Flint, Mich.....140	500W
KPG	Quanah, Texas.....140	250W
KPP	P't'ble—Okla., Texas.140	100W
KPK	Oklahoma City.....140	250W
KFWS	Br'sville, Texas 140	10W
KFWR	San Benito, Texas....140	10W
WDYC	Detroit, Mich.....140	500W
WJBF	Charleroi, Pa.....142	100W
WEQ	Baltimore, Md.....143	250W
WJX	Washington, D. C....143	50W
WJH	Washington, D. C....143	50W
WEY	Boston, Mass.....146	5W
KVP	Dallas, Texas.....146	100W
KJA	Pysht, Wash.....146	5W
KFZ	Portable—Cal. 146	50W
KGV	Portable—Cal. 146	50W
KYX	Portable—Cal. 146	500W
KZI	Portable—Cal. 146	500W
KJU	Culver City, Cal....146	50W
KYY	Los Angeles, Cal.....146	500W
KFV	Portable—Cal. 146	300W

Supports for Radio

ELEMENTS of permanent support for broadcasting in the United States are becoming clearly defined in several categories according to David Sarnoff, Vice-President and General Manager of the Radio Corporation of America. They are: (1) Contributions from the radio industry for the maintenance of broadcasting. (2) Goodwill and indirect advertising over the air. (3) Organized educational support including appropriations from Boards of Education and college endowments. (4) Organized social support including endowments to promote public health and social service. (5) Community broadcasting by the Chamber of Commerce and other civic organizations to advertise the advantages of cities and states. (6) Institutional broadcasting for developing the prestige of firms by means of high-class radio entertainment.

Radio Shows Scheduled

LATE summer and fall will bring forth several radio shows, widely distributed over the United States and Canada. Here is a list of them:

August 21-28—Annual Pacific Radio Exposition, Exposition Auditorium, San Francisco, California.

September 10-17—Fifth National Radio Exposition, Grand Central Palace, New York.

September 13-18—Radio Manufacturers' Show, New Madison Square Garden, New York.

September 13-18—Winnipeg Radio Show, Alexander Hotel, Winnipeg, Canada.

September 27-October 2—National Radio Exposition, Chicago, Illinois.

October 4-9—Pittsburgh Radio Show, Pittsburgh, Pennsylvania.

October 4-9—Montreal Radio Show, Windsor Hotel, Montreal, Quebec, Canada.

October 11-17—Radio Manufacturers' Show, Coliseum, Chicago, Illinois.

October 25-30—Second annual Indianapolis Radio Exposition, State Fair Grounds, Indianapolis, Indiana.

October 25-30—Radio Show, Coliseum, Toronto, Ontario, Canada.

Pictures Travel on Long Waves

BROADCAST listeners need have no fear that transatlantic radiophotograph transmission will intermingle with their musical programs. The pictures travel on wavelengths higher than 10,000 meters, while broadcasting stations operate between 200 and 550 meters. If it were possible for a broadcast receiver to tune in the pictures they would sound like dots and dashes. In the transmission of checks it would be difficult to distinguish between a dollar and a million dollars as far as the sound is concerned.

Time, Day and Date

STATION KGO, Oakland, California, signs-off with the time, day and date because of requests from listeners in the mountain and desert regions, who lose track of time.

Wide World

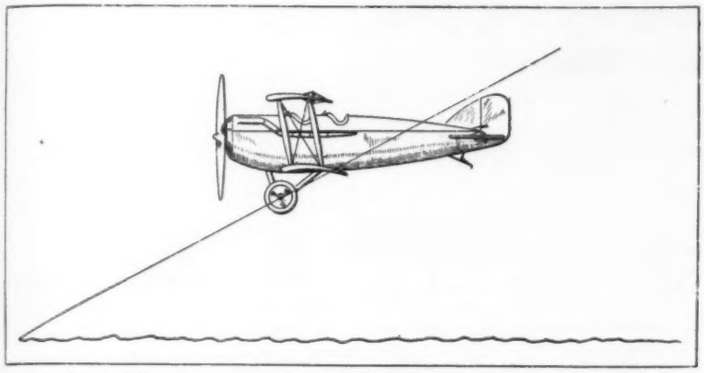
Dr. James Harris Rogers, of Hyattsville, Maryland, is shown here with the transmitter he uses for experimenting with underground antennas

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

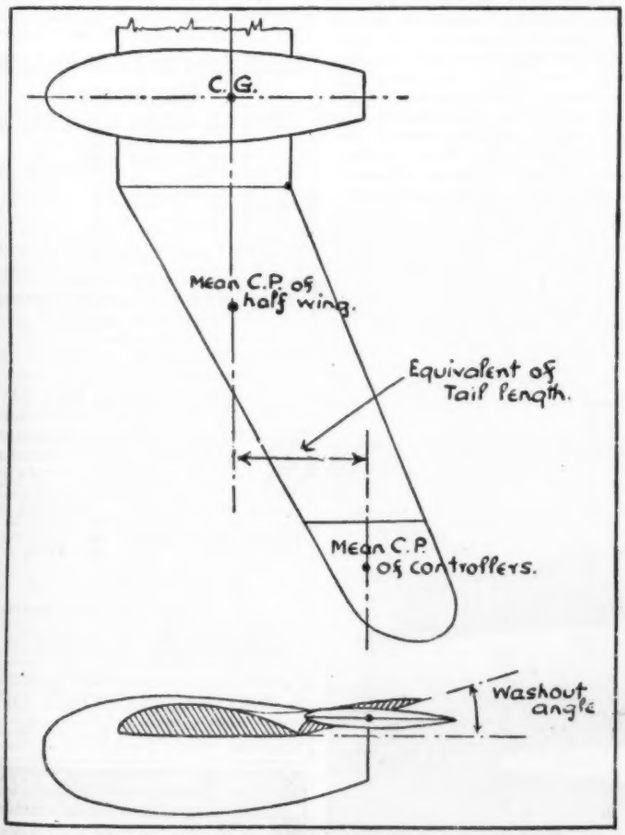


An airplane gliding down a steep path with its longitudinal axis horizontal; an ideal method of landing in a restricted field, if only control can be maintained when the wing is at such a large angle to the flight path

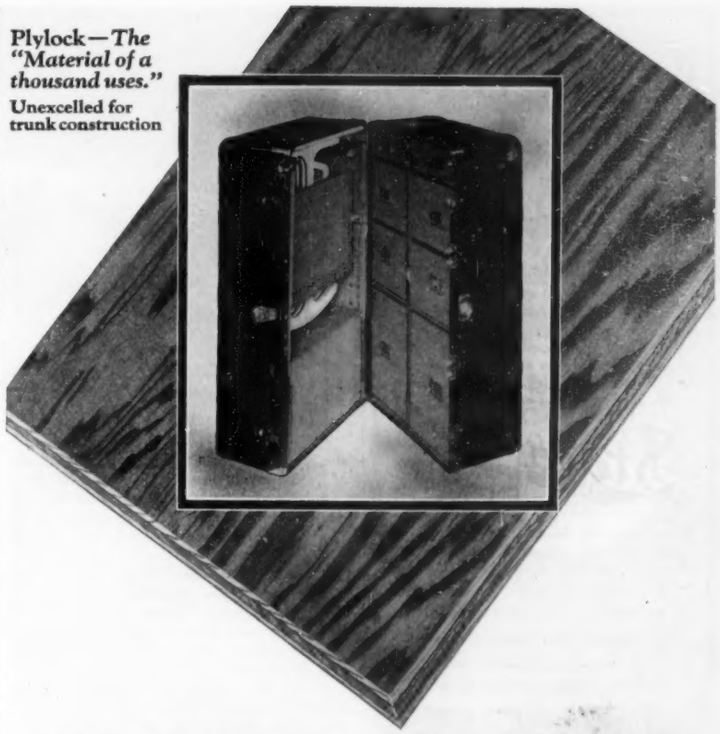
The Tailless Airplane

THE slower the landing speed of an airplane, the shorter will be the landing run, and the less the chance of disaster in an imperfect landing, or one made in rough ground. Unfortunately, even with a low landing speed, the pilot may have to make a long glide across the airdrome until he gets his machine in position for perfect three-point contact, the front wheels and the tail skid touching simultaneously. In a small field, or one surrounded by obstacles, there arises the problem of losing altitude without covering too great a distance in a horizontal direction. Pilots often resort to such devices as side-slipping into the field, or "fish tailing," a peculiar maneuver in which the pilot swings the tail of his plane from side to side. These maneuvers are not free from objection. The pilot must be able to time the recovery from such maneuvers very accurately and an element of danger is always present.

In a restricted field therefore, it would be desirable to be able to glide in on a steep path—so as to lose altitude without going forward too much. But this does not mean that the pilot should glide steeply with the nose of his machine down. He should glide steeply but with the axis of



A diagram of the Hill tailless airplane. The turning up of the trailing edge and the "wash out" at the tip, in combination with the sweepback, give a constant position of the center of pressure always coinciding with the center of gravity. Note the controllers hinged at the very end of the wing



Plylock—*The "Material of a thousand uses."*
Unexcelled for trunk construction

Plylock-built trunks —*for instance*

When you buy a trunk you expect two things—strength to withstand years of wear—and complete freedom from warping, binding, and splitting in the trunk body and interior fittings.

Plylock is the ideal trunk material—inexpensive enough for use in the modest locker trunk and fine enough for the best wardrobe trunks and other fine examples of the trunk-maker's art.

When you buy a trunk ask if it is constructed of genuine Plylock. If you manufacture trunks or cases, investigate this material. Plylock is the finest Douglas fir plywood that can be made, built up, according to Plylock standards, of selected fir veneers, permanently welded together with genuine Plylock cement. Plylock excels any known soft wood in its strength and ability to withstand shock and resist rupture—most desirable properties in materials for trunk construction.

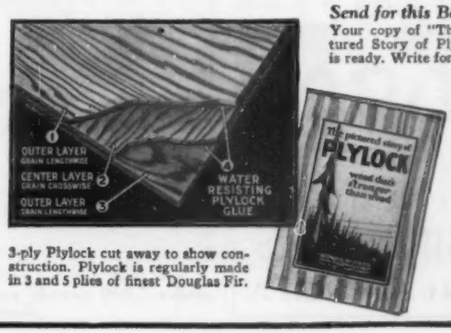
Manufacturers of automobile bodies, of cabinets, of phonograph and radio cabinets, shelving, paneling, doors, toys and novelties, desks and furniture and innumerable other articles, are using Plylock in place of lumber or ordinary veneers.

Write for a copy of "The Pictured Story of Plylock" and full information about this product. Samples will be gladly sent for experimental work at your own plant. Our research department is at your service.

PORTLAND MANUFACTURING CO., PORTLAND, OREGON
Plywood makers for 27 years.

PLYLOCK

"Wood that's *stronger* than wood"



3-ply Plylock cut away to show construction. Plylock is regularly made in 3 and 5 plies of finest Douglas Fir.

Send for this Book—
Your copy of "The Pictured Story of Plylock" is ready. Write for it.

Which Is Best?

To buy a substantial Stewart Fence, get the benefit of its guarding protection in preventing petty theft and other depredations about your factory, or pay as much or more through losses and still have nothing for your outlay, except a continuance of this annoyance and expense.

Stewart's STANDARD STYLE NO. 1 IRON AND WIRE FENCE

Wide choice of designs of Iron Fence or Chainlink Fence galvanized after weaving, allows the selection of just what suits your needs.

Let us quote you on your requirements.

THE STEWART IRON WORKS COMPANY
Incorporated
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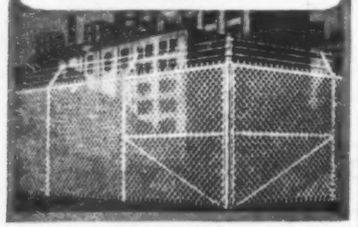

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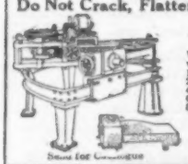

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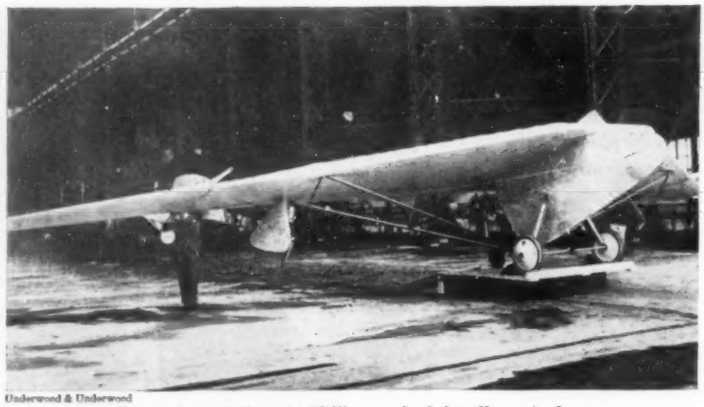


Underwood & Underwood

Front view of Captain Hill's wonderful tailless airplane

the machine almost horizontal. The chance of a nose crash then would be very slight.

Such a glide is theoretically possible with almost any machine flying at a large angle of attack to the path, in a so-called "stalled" condition, as indicated in the diagram. Unfortunately in "stalled" flight, there is serious danger of loss of control.

British statistics indicate that in the last few years, more than two-thirds of the fatal accidents have been associated with such loss of control.

Within the ordinary range of flight angles, the lift increases as the angle between the wing and the line of the wind increases. Any loss of speed is compensated for by an increase in this angle. But if this angle becomes too large, we reach a "stalled" condition, when further increase of the angle actually means loss of lift, and a violent drop of the airplane, which gives a flier the same painful sensation as a too rapidly dropping elevator. The drag also increases rapidly and slows up the machine. At the same time the center of pressure moves back violently, and the machine tends to go down by the nose.

At the same time, in the stalled condition the ailerons become largely inoperative, and when used to right a roll, tend to turn the machine off its path.

In a "stall," accompanied by a slight roll, this combination of unfortunate circumstances very frequently acts to produce a spinning nose-dive, in which the machine glides steeply to earth, while spinning round and round about an axis which is nearly its longitudinal axis.

Every good pilot knows how to recover from a "stall spin." He depresses his elevators so as to diminish the angle of incidence on the wing and diminish the "stalled condition," puts his aileron and rudder control in neutral and waits. Given sufficient height above the ground, the recovery of normal flight attitude is bound to follow, but if the height is insufficient, a bad crash may result.

A great advance in safety would follow, if a machine could be designed which could be "unstalled" at will and in which all tendency to "spinning" would be immediately checked.

This long and perhaps tedious preamble is necessary, if the full significance of the Hill Tailless Airplane is to be appreciated.

The tailless airplane is not entirely novel in its conception. The Burgess-Dunne, flown in the United States before the war, had swept back wings with the controls at the end of the tips and no fuselage.

Strictly speaking, the Hill *Pterodactyl* is not a tailless airplane at all. Rather, the tail has been attached at the end of heavily swept back wings, and the projected length remains practically the same as in a conventional airplane.

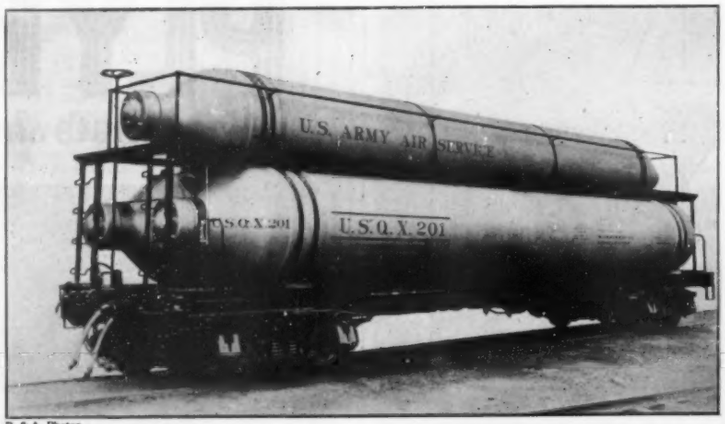
We show a diagrammatic sketch of this interesting machine and a photograph of the plane in the hangar.

The wing is not only swept back, but also tapered in plan form. The trailing edge of the wing is turned up, and at the same time its angle of incidence is diminished as compared with the central portions of the wing, or is "washed out" in airplane terminology.

The turning up of the trailing edge in combination with the washout produces a constant center of pressure. In other words the violent tendency for the plane to nose-dive at the "stall" largely disappears.

At the end of the fixed portion of the wing are placed two "controllers," symmetrically double cambered surfaces, balanced about their hinges. When depressed or raised simultaneously, the controllers act as elevators, and even though not at the end of the tail, they are far back from the center of gravity of the plane, and therefore have a powerful leverage. When used differentially, one turned up, and the other turned down, they act like ailerons.

Since the center of pressure on the wings is stationary, it always coincides with the center of gravity. Therefore, no force is normally required on the controllers to "trim" the ship and the controllers can be so adjusted that they always lie neutrally in the wind.



P. & A. Photos

A new tank car for carrying helium gas. The three large cylinders contain gas under 2,000 pounds per square inch pressure, which, when expanded to atmospheric pressure, occupy 205,000 cubic feet

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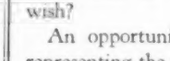

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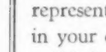

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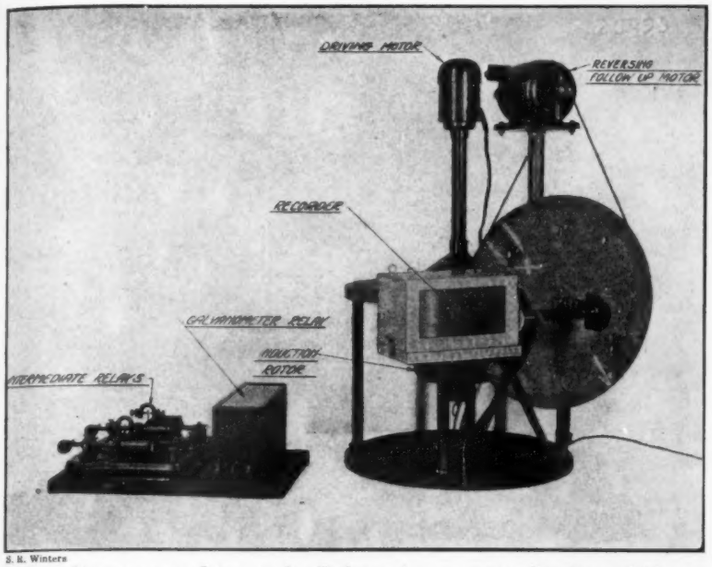


S. R. Winters

A recording compass that records all the various compass directions which an airplane may make in flight

With a conventional machine, when the wing is "stalled," the stabilizer is also at a large angle to the wind, and the elevators become inoperative just when their help is most required.

Further we have seen that the ailerons at the "stalled" condition tend to spin the airplane. In the Hill *Pterodactyl*, since the controllers are always neutral, they never lose their restoring power, and the resistance of the turned down "controller" is equal to the resistance of the turned up "controller." All tendency to spin is thus avoided.

As regards other features of the extraordinary craft, the usual fin and rudder have been replaced by two rudders placed at the point of attachment of the struts to the wings, and below the wings. Two fins are placed above the wing at the end of the fixed portion.

The body which has to carry no tail or tail skid loads, can be made very light and is actually built up of light balsa ply-wood. In the absence of a tail-skid, the landing gear has three wheels, with the rear wheel carried on a fork and supplied with a locking gear which acts as a brake. Owing to the short wheel base, the machine pitches while on the ground and seems to be in danger of turning over. As there is no fuselage, the plane is very conveniently arranged as a pusher, without the necessity of raising the thrust line far above the top of the fuselage. The *Pterodactyl* is equipped with a Bristol Cherub engine of 22 horsepower. It has an overall span of 45 feet, the area of the main planes is 223 square feet, that of the controllers 55 square feet, and that of the two rudders 13 square feet. The weight empty is 458 pounds and with gas, oil and pilot the weight is 658 pounds. The top speed is 70 miles per hour, and the minimum speed approximately 28 miles per hour. As far as structural weight or performance goes, the tailless airplane does not seem to be superior to the ordinary light airplane.

The real interest of the *Pterodactyl* lies in its wonderful flying properties.

The machine, while having a definite minimum speed, has no apparent stalling point. It can glide down on a path of 45 degrees and yet maintain its axis horizontal. It can fly stalled and pass instantaneously to flight below the critical angle of incidence. It can, at the slowest flying speeds, meet any lateral disturbance with ease and avoid the dreaded spinning nose dive.

While it is not at all probable that airplanes will henceforth be built in this tailless fashion, it is quite certain that the flying characteristics of the Hill *Pterodactyl* will be carefully studied, and these new aerodynamic principles applied to more conventional types of machines.

New Helium Tanks

THE sole source of supply of helium in the United States is at present at Fort Worth, Texas, many miles from the airship stations at Scott Field, Illinois, and Lakehurst, New Jersey. The problem of supplying the vast quantities of helium required in operations is accordingly a difficult one. At the request of the Army Air Service the Bethlehem Steel Company has constructed a special gas-carrying unit. This unit is in the form of a tank car composed of three large cylinders. The three cylinders will carry 205,000 cubic feet of helium at a pressure of 2,000 pounds per square inch.

Before the development of this tank car, the helium gas was carried in small cylinders, 1,200 of which were necessary to inflate an airship of 210,000 cubic feet capacity. In emptying the small cylinders about 15 percent of the gas was lost through leakage.

The development of the large tanks not only reduces this waste, but cuts down the work involved in tapping a multiplicity of small cylinders.

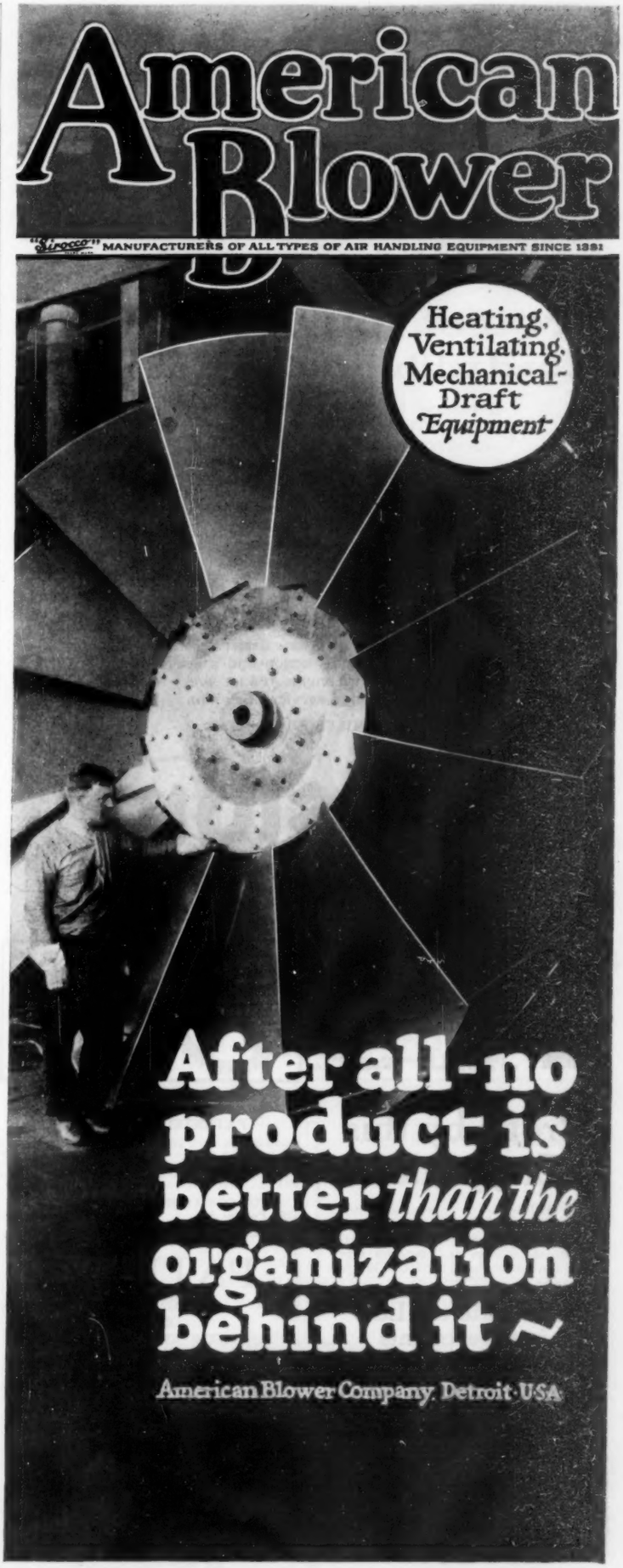
A Recording Compass

THE Engineering Division of the Army Air Service has recently perfected a device which records on a paper chart, by means of pen and ink, all the various compass directions which an airplane may make in flight, no matter how intricate the variations in direction may be. In a recent flight made from McCook Field, Dayton, Ohio, to Eaton, Pennsylvania, and then back to Dayton, the device recorded the direction of route throughout the trip with complete accuracy. As far as we know this is the first recording compass ever constructed and it may have important applications in charting airways.

We illustrate various parts of the device; the chart which revolves by clockwork; the driving motor which actuates the pen; the reversing, follow up motor; relays and so forth.

Unfortunately the full details of the device have not as yet been disclosed. We can make shrewd guesses only.

The compass, preferably of the earth inductor type, is placed at the tail end of the fuselage where it is free from disturbing magnetic fields. An electrical contact device works with the compass in such manner that as long as the airplane is heading due north, contact is broken. When the airplane deviates from true north, contact is established, and the driving motor sets the recording pen in motion. But if the driving motor were to continue indefinitely at work, the pen would end by marking an enormous deviation from the north. We imagine that simultaneously with the movement of the driving motor and the pen, the reversing,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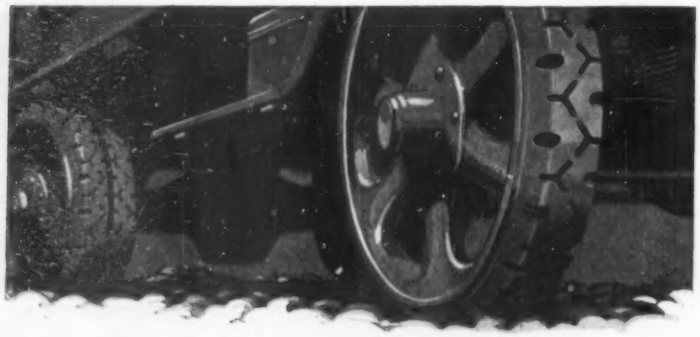
Photograph Shows Large Disc Fan for Use on Cooling Towers



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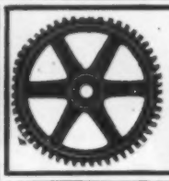

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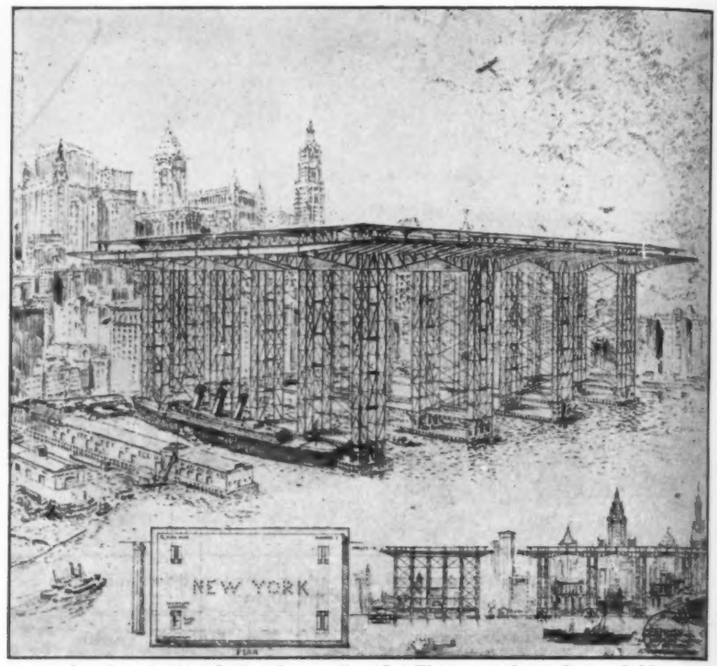


A prize-winning design for an "artificial" metropolitan flying field

follow-up motor changes the position of electrical contact, so that when the driving motor has displaced the pen to an amount corresponding to the route deviation, contact is again broken and the movement ceases. Perhaps our readers may find an even more plausible explanation.

The Metropolitan Flying Field

NOW that commercial air transport is coming rapidly into being, the question of flying fields, readily accessible to city centers, becomes of paramount importance. Good flying fields are apt to be either prohibitive in cost, too far from the center of a city or else, if well within city limits, to have poor approaches. Hence the offer of a prize of one hundred dollars to the students of the Beaux Arts Institute of New York for the best plan of an "artificial" metropolitan flying terminal.

While Messrs. Brainerd and Hammarberg obtained only second prize, their design is a most interesting one. It provides for a huge steel structure to be erected over steamship piers or railroad yards, sufficiently high to minimize approach dangers, and 1,000 feet square, providing ample alighting and getaway space for a modern plane. The structure would be provided with two levels, an upper level for flying operations, and a lower level for repair shops, gasoline filling stations, waiting rooms, etcetera. The lower level is to be provided with a cantilever extension to serve as a safety cage in case of mislanding. Specially designed lifts are to be provided for transferring planes from the landing deck to the service level. Many problems that would tax the ingenuity of inventors and engineers to the full remain to be solved in connection with a structure of this kind. But there is nothing fantastic or insuperable in these ideas.

It is estimated by experts that such a platform could handle 30,000 planes a year, which should be sufficient for some time to come!

A Projected Transatlantic Flight

THE recent spectacular flights over the North Pole have their value as a general stimulus to aeronautical interest. But a flight across the Atlantic, non-stop from New York to Paris, planned to take place this summer, may have consequences of a more practical character. The "Argonauts" a group of sport loving American business men, organized by Colonel H. E. Hartney, commander of the First Pursuit Squadron during the war, is financing the flight in generous fashion, sufficient to provide a really excellent plane, every special device that science has developed for purposes of navigation, and the best possible personnel obtainable.

The plane is being built by Igor I. Sikorsky, a native of Russia, who built his first plane in 1910 and has since had a career of unbroken success with multi-motored planes as his specialty. A gentleman of the old school, Mr. Sikorsky combines with real technical knowledge, a skill in piloting and a practical knowledge of flying operations. The man who is to take command of the plane is Réné Fonck, French "ace of aces," who has nearly a hundred planes to his credit in the great war. Alert, determined, coolheaded, a first-class engineer as well as a pilot, Fonck is just the man to add another laurel to his crown by such a flight.

Captain Réné Fonck, of the French Army Air Service, hero of a hundred air battles, who is to pilot the S-35 in its projected non-stop flight from New York City to Paris

That the expedition is not wholly dependent on European talent is gratifying. The plane is being built on Long Island and the navigator and radio operator or assistant pilot are both to be former American navy men.

The route has been most carefully planned. The length of the flight is 3,633 miles from Roosevelt Field, Westbury, Long Island, to Le Bourget, the great airdrome just outside Paris. If all goes well, this distance is to be covered in 36 hours, at an average speed of over a hundred miles an hour. The plan is to leave Roosevelt Field in the

S-35, as the plane is called tentatively, at 5 o'clock in the evening, when the air is calm, sail over New York City, up to Boston and fly along the coast by night when the chances of head winds are slight. The frequent beacons will provide night landmarks which would be absent over the North Atlantic. The course is then to Halifax, Cape Breton and Cape Bonavista, and the aviators will bid the continent goodbye at Newfoundland. The *S-35* will then fly along a great circle, the shortest path between two points on the earth's surface and coincident with the great steamship lane of the North Atlantic. After passing over the southeast tip of the coast of Ireland, Cornwall, Cherbourg and Havre, the *S-35* is scheduled to reach Paris at 11 o'clock of the morning of the second day.

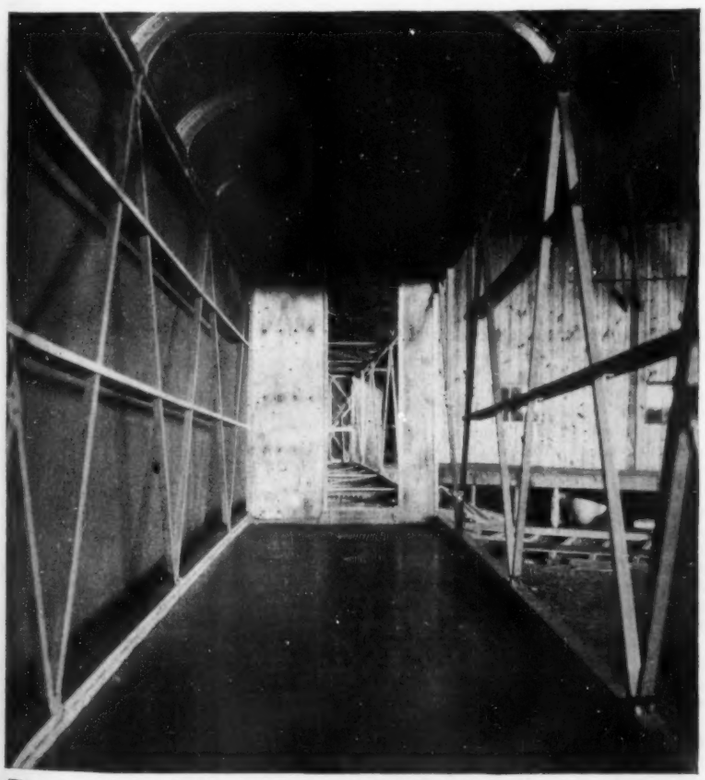
The great, technical difficulty in the design of the plane was the provision of sufficient gasoline for the 36 hours of projected flight, with sufficient reserve for untoward winds and other difficulties. The actual load of gasoline and oil provided in the huge tanks is 15,200 pounds or approximately 2,500 gallons. This is perhaps the largest amount of fuel carried aloft at any time in a heavier-than-air craft of any type.

Unfortunately in the airplane, it is not sufficient to increase the tank capacity to get greater flying range. The gross weight of the plane is severely restricted. Endless calculation and innumerable changes in initial design were necessary before the problem of transporting this huge quantity of gas was solved. The solution was finally reached by refinement of structure, so that with adequate structural safety, the *S-35*, with a gross weight of 24,000 pounds, only weighs 8,000 pounds empty of gas, oil and crew; and by the bold conception of loading the wings to their utmost capacity at the start of the flight. The average mail plane is loaded to 10 pounds per square foot of its wing area. The *S-35* when it leaves Roosevelt Field will carry the unprecedented load of 21.85 pounds per square foot. As fuel is consumed on the long journey, this overload will gradually disappear. But at the moment of departure, the plane will have to make an exceptionally long run and attain a far greater speed than is necessary with other modern airplanes. The getaway will provide an anxious moment for the pilot. Sikorsky and his associate engineers will heave a sigh of relief when Fonck has reached a reasonable altitude and flown his heavily loaded plane safely in the direction of Manhattan.

Throughout the journey, the pilot will watch his fuel gages carefully and compare them with the distance shown on his air-speed recorder, which replaces in the air the log of a seagoing vessel. Careful calculation has determined that the best economy of the flight is to start with all motors in action, then to change to the two outboard motors as the load lightens, and subsequently throttle down the two motors still being used.

One of the interesting technical points of the plane is that while heavily overloaded for this particular trip, it is in reality a practical passenger plane, which under normal circumstances can provide a passenger capacity of twelve in a comfortable cabin, or a freight capacity of 450 cubic feet. It can carry this load at a speed of approximately 140 miles per hour, which is perhaps the greatest speed ever planned for a passenger plane. With a span of 101 feet for the upper wing, 76 feet for the lower plane and a total area of 1095 square feet, the *S-35* is built entirely of metal. Duralumin "I" sections and angles are used with the fabric cover as the only non-metallic material entering into the structure. The plane as built for a record flight, will be entirely serviceable in commercial aviation.

Special precautions for a forced landing in mid-ocean have been carefully provided, but the greatest precaution against a forced landing is in the reliable power plant. It has been sought to attain such reliability in a number of ways. For example the fuel feed to the motors is by gravity from central gravity tanks containing four hours' fuel supply. The use of air-cooled air engines eliminates the troubles of water-cooling which are responsible, as a rule, for the majority of power plant failures. The powerful Bristol Jupiter engines of 425 horsepower each, are as reliable a type of aircraft engine as we have today and have passed the severest endurance tests. By far the greatest measure of security lies in the employment of three engines. Mr.



The roomy interior of the cabin of the *S-35* with its solid side trusses of duralumin channels. The rounded metal frames at the top complete the structure of the wing truss yet avoid the necessity of a single brace or wire in the cabin. At the rear is the door leading to the pilot's cockpit

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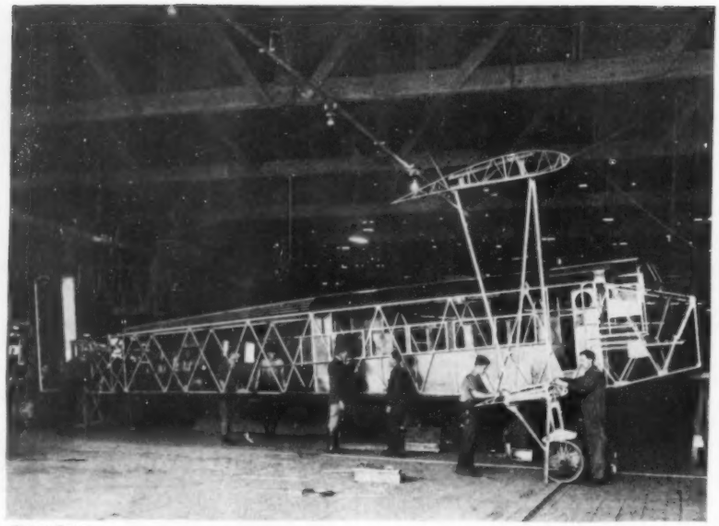

Herbert Photos

Preparing for a long flight. Workmen assembling the *S-35* at the Sikorsky plant on Long Island. The huge craft is built entirely of the metal duralumin. Its structure is everywhere like that of a flying bridge. Note the solid "Warren" truss in the fuselage, a type familiar in every steel structure. Even the ribs, which maintain the outline of the wing, are built on the sound and tried principles of structural steel work. The illustration shows the central fuselage not yet covered with fabric, and the rigid engine mount at its front end

Sikorsky estimates that even at the beginning of the journey it will be possible to continue flight on any two of the three engines. At the end of the journey one motor will suffice to maintain flight. Engine breakdowns of a simple character may therefore be remedied in flight by a skilled mechanic, and the probability of forced landing in mid-ocean become very remote indeed.

However, Fonck, in spite of his heroic record, is cautious. Provision has been made fully for the improbable forced landing. Walls, floor spaces and all convenient points in the fuselage have been stuffed with air bags, which in addition to the emptied tanks can give indefinite flotation. Radio transmission and receiving apparatus of short wave length with waterproof batteries, rockets, Very pistols and a collapsible floating mast guarantee means of communication with vessels passing within a wide range of the fliers. Three collapsible rafts, such as used on the Byrd expedition will make it possible to pass from one point of the plane to another if any repairs are to be made while at sea.

Nor are special appliances lacking, other than safety devices. The navigator shooting the sun with his sextant, is protected from the rush of air by a special shield. The magnificent American earth inductor compass and every other navigational appliance will be available. The cockpit can be entirely inclosed in inclement weather. A comfortable air mattress will invite sleep for the man off duty. A French touch: "attractive food supplies will be available, with hot chocolate, tea and coffee."

There is no doubt that the flight is of practical utility. Success may be the precursor of regular mail service across the Atlantic. In commercial operation there undoubtedly would be intermediate stops between the two great cities. The lessened load of gasoline would allow a respectable pay load to be carried in the form of letters or possibly Paris hats of the very latest fashion.

Beaching a Flying Boat

IN an interesting article in *Flight*, R. J. Mitchell discusses the ground operation of flying boats. Sometime in the future flying boats will undoubtedly reach a stage of development, where it will be possible to moor them for indefinite periods in a sheltered harbor, much as it is possible to moor an ordinary ocean going vessel. They would then only go into dry-dock for extensive repairs. But as matters stand at present, wooden hulls and fabric covered wings make the flying boat too delicate for lengthy sojourn in the water, and in very windy weather they often tear from their moorings. Therefore it is customary to beach them as soon as possible after alighting.

Beaching a flying boat weighing several tons, and with a wing spread of sixty or seventy feet is not too easy a matter. Anyone who has tried to beach even a small motor boat will appreciate this thoroughly. A variety of methods have been tried for easier beaching. Very frequently a "beach cradle" is used. This consists of a cradle mounted on swiveling wheels, which is made to fit the bottom of the hull amidships for a considerable portion of its length.

Unfortunately the beach cradle takes up the weight of the hull through places not originally intended to take the loads. The bottom of the hull also forms a very narrow base for support in comparison with the span, and the flying boat has a tendency to rock while being handled, or even when at rest in a light breeze. Particularly dangerous is the moment when the cradle has been moved so far up shore, that the boat ceases to be water borne. As a result of these difficulties, more damage is caused to the flying boat while on the cradle than in the rest of its normal career.

The development of amphibians has suggested a very different form of apparatus in the form of a special "beaching chassis." The chassis is made in two parts, one to fit each side of the hull. Each part consists of a light tubular frame built on a bent axle carrying an airplane wheel. An adjustable strut is pinned to the bent axle in such a manner that it is free to swivel and gradually release the hull until it rests on the ground. The "beaching chassis" is made to attach to those portions of the hull where the wing struts are attached, so that the transmission of loads occurs through a part of the hull which is designed to carry them normally. It is readily seen that all the difficulties of the "beaching cradle" disappear. The new "bleaching chassis" provides adequate support, a wide base which makes "rocking" impossible, and it is readily attached while the flying boat is still afloat.

It is with the development of such simple devices that ease of handling and the possibility of commercial operation of aircraft will come.

It is noteworthy that British seaplane operators have found it advisable to put roller skates under the "beaching chassis" and have thus moved the huge boats about sideways in closely packed hangars, without the usual backward, forward and sideways maneuvering!

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Airplane Arresters

THE problem of restricting the travel of a rapidly moving airplane after it has once landed has long engaged the attention of aeronautical engineers. For ordinary land flying, a sufficiently short run has already been attained. For example, the latest type of mail plane, heavily loaded though it is with 1,000 pounds of mail, and 100 or more gallons of gas, will pull up in a distance of less than 300 feet. This has been achieved very simply by the employment of high lift wings, and a wing area which is large relative to the total weight of the airplane. The provision of trailing edge flaps, or of Handley Page slots, which increase the lifting capacity of the wings at the moment of landing, will decrease the run still further. Brakes on the wheels have been tried with some measure of success, although they entail the danger that if violently applied, the airplane may tip over on its nose. But even without brakes on the wheels or any other special device, the landing run of the commercial airplane is already short enough for any but the smallest emergency fields.

On board an aircraft carrier, the distances available are necessarily very short, and there is still more reason why the plane should pull up short here than on land. As long as it is in motion, there is always a danger of its going overboard in gusty weather.

The first successful experiments with an arrester were made in 1911 when Eugene C. Ely landed on the deck of the *U. S. S. Pennsylvania* in San Francisco Bay. Ely's airplane was equipped with hooks on the undercarriage which engaged a series of wires, stretched athwartships and therefore at right angles to the path of the airplane. These wires were connected to sand bags at either end. The tendency to nose over was resisted by a long skid projecting ahead of the chassis.

In 1917, Hazen C. Pratt, a mechanical engineer of Rochester, attacked the problem systematically and soon formulated the following requirements for a successful arresting gear:

It must be of the simplest construction possible, complication increasing cost and the risk of failure.

The apparatus carried by the airplane must be light in weight, must not add appreciably to the air resistance in flight, nor interfere with the normal functions of the airplane.

A single engagement with the airplane must be relied upon to destroy speed and to maintain the plane in correct position, without the assistance of a front skid or wheel to prevent nosing over.

In case of failure to engage, the pilot must be able to continue his flight; nothing would be more disastrous than to fail to make engagement yet to be unable to "zoom" off for another attempt.

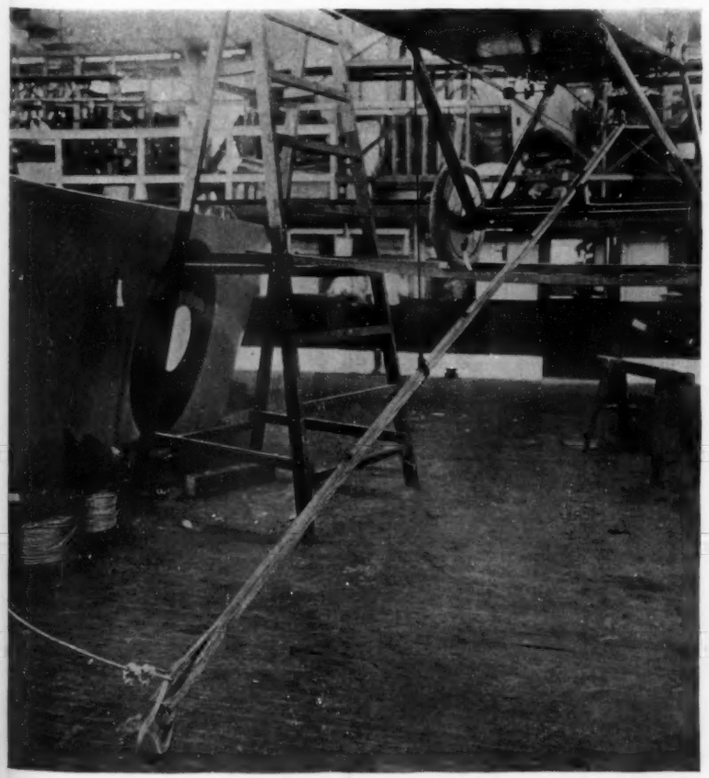
There should be a reasonable leeway within which to engage, two or three feet vertically, and ten to fifteen feet laterally being considered sufficient.

The gear should permit engagement at a moderately high speed, since to land at the slowest possible speed means to lose aileron control, and to make the effect of gusts much more disturbing.

The apparatus which Pratt finally worked out and which has stood service tests successfully on the aircraft carrier *Langley* is simple, yet meets these requirements fully.

It consists of a cable or chain, or a series of cables or chains, stretched as usual parallel to the landing surfaces and at right angles to the path of flight. The ends of the cables are each connected to a braking appliance. The apparatus on the airplane consists of a pole, pivoted at one end to the airplane and carrying a hook at the free end. The hook is connected to the fuselage at some point well to the rear of the center of gravity of the airplane, and some means is provided for raising and lowering the pole.

On making a landing the pilot lowers the pole before he approaches the landing surface, so that the end of the pole carrying the hook projects a short distance below the wheels of his plane. He flies over the stretched cable at such an elevation that the wheels of the plane are within three to four feet of the landing surface. The chain or cable is struck by the pole and guided into the hook. The connection which is now established between the airplane and the braking or retarding appliance allows the application of a relatively large retarding force to the airplane and brings it to rest in a short distance. The line of force passes from the center of gravity to the point of attachment in the rear, so that all tendency to nose over is eliminated no matter how violent the braking force applied. The solution is good engineering practice and well worked out.



Airplane arrester assembled on airplane as used during demonstration

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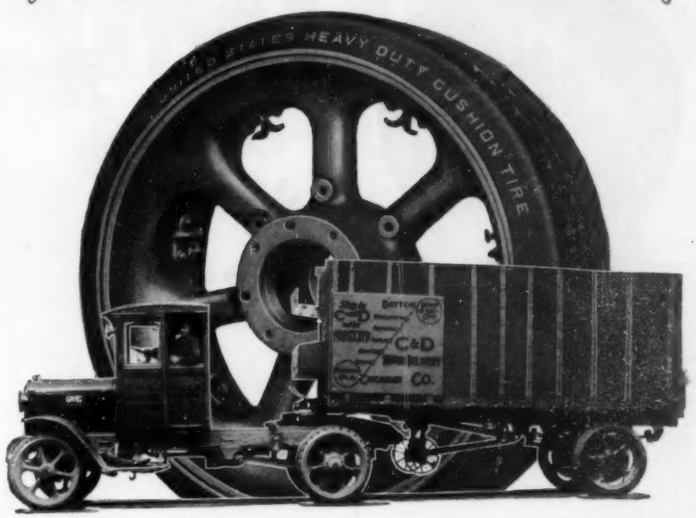

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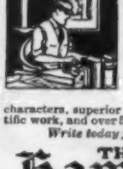

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Worms That Turn

In the June issue, page 418, we reproduced a striking photograph of the curved designs traced on the inside of the bark of a tree by the boring of worms. These designs were extremely artistic. In reply to this note we have received the following comment, from a government insect scientist.

Editor, Scientific American:

I was very much interested in the note "In the Editor's Mail" found in the June, 1926, issue of the Scientific American entitled "Must We Cease Using Them for Bait?" and signed by Mr. Paul E. Denton. The photograph indicates that the larva making the galleries is one of the barkbeetles and from the appearance of the work I believe that the insect responsible is the hickory barkbeetle (*Scolytus quadrispinosus* Say). It is of course possible that the work is that of another species and on a different host tree, material alone being the basis for a positive determination.

Many of the barkbeetles attack living trees and by mining between the bark and wood kill the infested tree. Different groups of these barkbeetles also produce different types of galleries. Frequently the patterns traced are artistic and have design possibilities.

Very truly yours,
William Middleton,
Assistant Entomologist, U. S. Dept. of Agriculture, Bureau of Entomology.

We Are Being Broadcast in Australia

From Australia comes the news that our articles are being broadcast by an enthusiastic reader. Of course we are not at all surprised at the subsequent demand for copies of the magazine (ahem!). In addition to his radio activities, Mr. Reed is going to build a telescope and has ordered a book to tell him how. The book is on its way, and we predict a "thrill that comes once in a lifetime" when our reader gets a close-up of the heavens through his own handiwork.

Editor Scientific American:

The most interesting and instructive article in the February issue of the Scientific American by Mr. Russell W. Porter on "Mirror Making for Reflecting Telescopes," has filled me with the desire to try my skill in this direction, having been interested in astronomy since my school days back in 1910. Enclosed please find money order for two dollars to cover the cost of the book he suggests, *The Amateur's Telescope*, by Ellison.

Under separate cover I am forwarding letters to the Bureau of Standards for the Letter Circular LC32 on the Silvering of Glass, and also one to Mr. John Pierce of Springfield to obtain his estimate of the total cost of the materials and the express charges on them for shipment to me in Australia.

I am in the capital city of our northern state attending to the installation of a five-kilowatt broadcasting station for the Queensland Government Radio Service. During the preliminary tests last week I read many articles from the January and the February issues of the Scientific American before the microphone, and as a result local news-agents inform me that they have been flooded by inquiries for copies and that several have placed standing orders for the magazine. The articles on "The Movement of the Continents," and "Soil Analysis in North Carolina" were greatly appreciated by the different sections of the local University.

If we can arrange it before I leave for the south we are going to try and put across a program for the listeners on the Pacific Coast. Our normal night transmission from 8 P.M. to 10 P.M. will coincide with 2 A.M. to 4 A.M. in California allowing an ideal condition for long-distance transmission. Our wavelength is 385 meters (780 kilocycles).

Joseph G. Reed.
Sydney, Australia.

Anent "Old Ironsides"

As we expected, our article about "Old Ironsides" awakened a response in many patriotic hearts. Edwin B. Eddy, Jr., suggests that the old frigate be relieved of some of the enormous weight she is carrying. Reader, we are with you! If we had fought so gallantly, we'd appreciate any efforts to alleviate a burden of 68,100 pounds!

Editor,
Scientific American:

I was pleased to note in the July edition of your magazine the excellent article on the frigate *Constitution*. I have been aboard the vessel twice, and have been very sorry to see the deterioration of this monument to a noble past. If the Government decides to keep the *Constitution*, there is one item for her preservation that I feel ought to be called to your attention and that of the public. That is that her spar-deck battery is both inaccurate from an historical standpoint, and weakening to the ship. Her armament on the gun deck is correct, but she is undoubtedly being hogged by the continuous and unnecessary pressure of twenty-four long 24's on her spar-deck. She never carried—no frigate of that period ever carried—such a battery upon her quarter-deck and forecastle.

In her battle with the *Guerriere*, August 19, 1812, which may be considered her best action, the *Constitution* mounted the following guns: gun deck, thirty long 24-pounders; quarter deck and forecastle, two long 24-pounders, one long 18-pounder, and twenty-two 32-pounder carronades. When it is considered that a long 24 weighs approximately 4,500 or 5,000 pounds, and that a 32-pounder carronade, only 1,700 pounds, think what a weight would be removed from this ancient vessel, if her twenty-two superfluous 24's were replaced by 32-pounder carronades in replica! With this removal, and the bringing aboard of a long 18 for the sake of adhering to history, the vessel would be relieved of from 57,100 to 68,100 pounds.

The *Constitution* received her 32-pounder carronades after the Tripolitan War, in which her spar-deck batteries, consisting mostly of 42-pounder carronades, were found too heavy for the hull. As a 42-pounder carronade is a compar-

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atively small and light gun compared to the heavy long-guns she now carries on her spar-deck, what must be the destructive effect upon her, from her upper batteries? This situation seems to have been overlooked, and I respectfully call it to your attention.

Yours truly,
Edwin B. Eddy, Jr.,
Duluth, Minnesota.

The Pink Turtlehead is Rediscovered in Virginia

This flower is apparently familiar to a number of our readers who have written us saying where it could be found. As lack of space does not permit our publishing all of these letters, we are using the one which reached us first:

Editor of the Scientific American.

Dear Sir:

In reference to the article in the last Scientific American on the pink turtlehead.

I have seen this plant blooming on the banks of a small stream that flows into the Tuckahoe creek in Henrico County, Virginia. The stream is about eight miles west of Richmond. It is south of the River Road. I think I saw the turtlehead blooming there last summer.

The plant that I know as the turtlehead was identified, several years ago, by reference to Dana's "How to Know the Wild Flowers," page 100, fourth edition, 1893.

Hoping that this information will be of interest to you.

I am yours truly,
A. P. Wickham,
Woodside, Lorraine, Virginia.

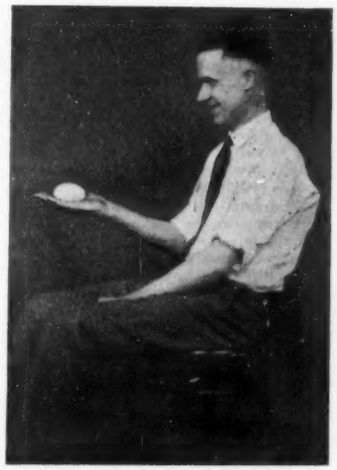
A Man's-Size Egg

We have heard of Two-in-One Shoe Polish and Three-in-One Oil, but this is the first time that a two-in-one egg has been called to our attention. A Rhode Island pullet in the State of Ohio is responsible for this, according to the following communication:

Editor Scientific American:

I am sending you a photograph made from an X-ray of a freak and abnormal hen's egg. This egg was laid by a nine-month Rhode Island pullet. The egg weighs exactly four and one-half ounces. The exact measurements are four and a half inches in length, five and three-quarters inches in diameter and nine and three-quarters inches around in length. The large egg, as you will note from the X-ray photograph, has within it another egg, perfectly formed, including a complete shell.

The large egg was boiled until hard and when cut in half was found to be exactly as shown in the photograph. The inner egg had a hard shell and



This illustration shows the unusual size of this two-in-one hen's egg

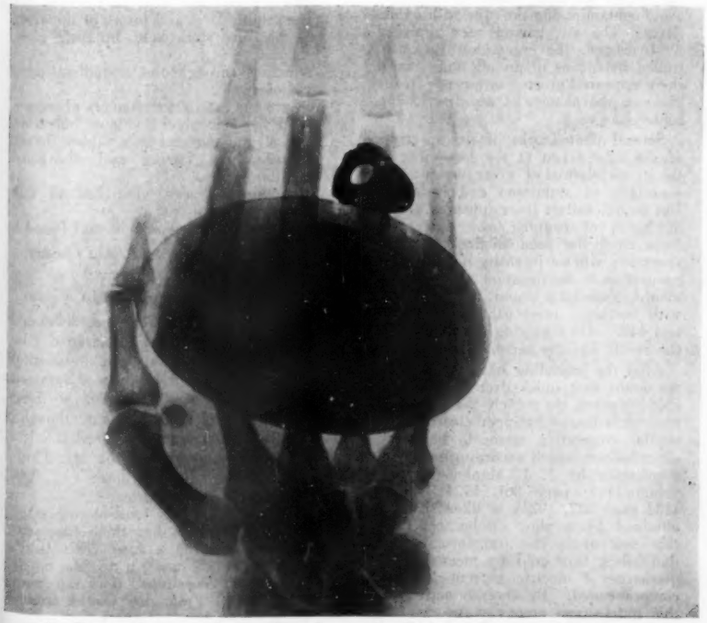
looked in every respect like any ordinary egg, containing yolk and albumen. The space between the inner egg and the shell of the large egg was also filled with albumen and contained a yolk in one end.

A. J. Brust.
Kent, Ohio.

Transmutation of Gold Into Quicksilver, a New Method of Attack

A new way to effect a transmutation has been tried by Dr. A. Guschler, of Berlin. He shoots hydrogen particles into the nucleus of the gold atom. This method ought logically to produce quicksilver (mercury), and according to Dr. Guschler, mercury was obtained. Those who demand rigorous standards of laboratory work will doubtless remain partly unconvinced about the results claimed, owing to the fact that a mercury-vapor pump was used. It is stated that this was employed only at first, and doubtless extreme precautions were taken against the accidental contamination of the results by mercury from the pump. Can this be absolutely guaranteed? Doubt will probably exist in the minds of many until other methods are devised. In the following letter Dr. Guschler describes his work:

By the experiments of Miethe, Nagaoka, and the author of this subject it has been sufficiently demonstrated that it is possible, under certain conditions, to transform quicksilver into gold by electro-thermal treatment. Soddy and others suggested that this might be accounted



An X-ray photograph showing the perfectly formed egg within an egg

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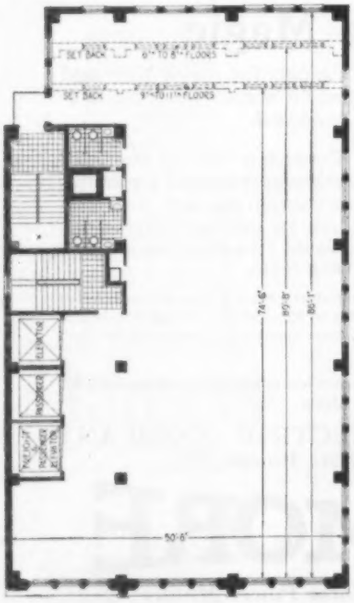

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for on the assumption that the isotope of quicksilver of atomic weight 197 absorbs an electron and thereby turns it to gold. This assumption has been refuted by an article by Aston in *Nature*, according to which it has been found that there is no isotope of quicksilver existing below *198*. A determination of the atomic weight of an atom of artificially produced gold by Hönigschmid gave a weight of 197.26.

Therefore the gold could, under no circumstances, be obtained by the absorption of an electron by a quicksilver center; so that there remains only the possibility that quicksilver turns into gold by the elimination of a hydrogen center. *Vice-versa*, gold receiving a hydrogen center must be transformed into quicksilver.

As it has been impossible to observe with certainty up to date the presence of hydrogen when producing gold from quicksilver, it was undertaken by the author to study experimentally the influence of hydrogen on gold, in the hope of producing quicksilver from gold and hydrogen. At present the literature gives no information as to what extent a hydrogen particle or nucleus might penetrate into other atoms, especially greater ones. It can be assumed that the hydrogen nucleus, because of its extremely small size, can easily penetrate into the spaces between the electrons of an atom when possessing sufficient kinetic energy. If it proceeds through the outer electron rings and is stopped by the repulsion of the nucleus, it cannot return to the surface of the atom in consequence of being bound by the inner electrons. The result is the contrary of the well known hydrogen connections (for example HCl), that is, an inner connection of hydrogen which is perhaps identical with a transformation of the atom, with the hydrogen nucleus bound in the interior of the other atom presenting a para-nucleus, as was confirmed with regard to quicksilver by many authors, especially by Nagaoka. With this in mind the experiments of the author aimed at shooting hydrogen particles into gold atoms and determining the eventual modifications of the gold either chemically or physically.

Hydrogen particles with great kinetic energy are best produced with a canal-ray tube provided with palladium-osmium regeneration. In my experiments I used a glass tube about 50 centimeters in length and 4 centimeters inside diameter, containing a pin anode, a flat sieve cathode of aluminum in the channel at 3 centimeters distance from the latter, and a plate of fine gold held in place by insulators attached to the glass tube.

After the inner equipment had been glowed out well, the evacuation was carried out by disconnecting the mercury-vapor diffusion pump in order to avoid contaminating the tube with quicksilver. The air, having been replaced by hydrogen, the evacuation was continued by means of an oil pump, until there appeared green fluorescence in the glass on the passage of an electric current.

Several photographs of the spectrum of the tube taken at the beginning of the trials showed a great many lines, especially of aluminum and hydrogen. But no quicksilver lines appeared. After 30 hours of running, the quicksilver lines could be seen distinctly in the spectrum with an intensity increasing in proportion to the duration of the experiment. Especially could there be seen with certainty lines 6152, 5461, 5670, and 4487. On repeating the experiment the result was the same.

After the preceding statement there is no doubt that quicksilver represents a gold-hydrogen, in which the hydrogen nucleus is bound by inner electrons. A similar connection seems to be quicksilver-helium, which according to a communication by J. J. Manley (*Nature*, volume 114: page 861, 1924; volume 115: page 337, 1925) is likewise to be obtained by a glow discharge. From this new angle the transformation of quicksilver into gold by means of the discharge of electric current is easily comprehended. By intense activity of the quicksilver atom an overload of positive electricity is produced, which is equal to the loosely held hydrogen nucleus. This is then expelled from the atom of quicksilver.

If the labors are pursued intensely on this basis, chemistry will soon be enriched by a great number of inner hydrogen and helium associations to which group quicksilver and others may be found at a later date to belong.

The author of this report would see the most favorable aspects for his work if an American institute would procure for him the opportunity to pursue his experiments under better conditions in the United States.

Dr. Guschler,
Berlin, Germany.

Poetry in Science

The father of one of our youthful readers believes that the Scientific American has helped to develop in his son a research trend of mind, and that the piece of blank verse which we are very glad to publish herewith was written as a result of his having pored over our columns. We are glad to know that our young subscriber has found in science the beauty which escapes the eyes of many.

Editor, Scientific American:

My son, Bryant Chester, nearly eighteen, has been a subscriber to the Scientific American for several years, during which time he has developed a research trend of mind along electron lines. In his English work at school he is required to write something original each week in prose or verse. He has just turned out a piece of blank verse of which I am naturally proud.

I am sending the attached copy to you as, no doubt, this reflects the influence of his reading your publication. It is also interesting to note that he has caught something of the spirit of his distant cousin, William Cullen Bryant.

M. E. Chester.

EXCURSIONS OF THE MIND

If man could but conceive himself to be,
Far smaller than the smallest speck of dust,
And further, still reduce himself in size,
Until that speck of dust seemed greater than
This very world that travels round the sun;
What then might be revealed before his eyes?
All substance, as we see it now would fade,
And change to fast and geometric shadows.
A weird and restless light would dominate
And fill all space, and silence would prevail.
So, from his tiny perch, man then could watch,
And marvel at the strangeness of his world,
And see and feel with an unaided eye,
The mighty laws and forces of the atom.
As are the stars held in their given course,
Whirling through the boundless paths of space,
So are the smallest rudiments of matter,
Held to their place by laws inflexible.
Yet, all this may not be a wildest dream,
Composed of fancies and disordered thoughts,
Man never knows what lies in wait beyond,
Until his mind has sought and found it first.

Bryant Chester.

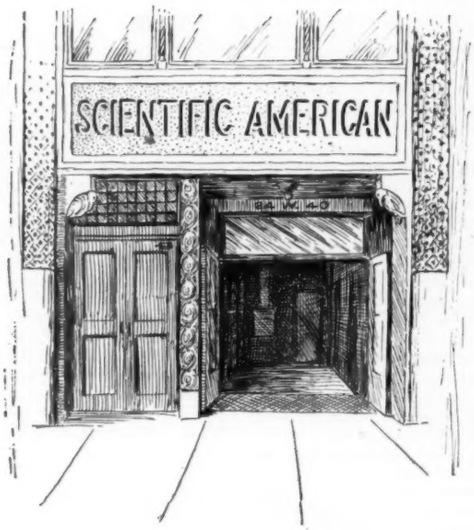
A Pardonable Slip

As there is such a close association between "sweetness" and "fragrance," it is not surprising that Mr. Miyake substituted one for the other in his microscopic reproduction of the verse from Gray's "Elegy." We are just naturally curious, though, to know how many readers noticed it. It did not get by the eagle eye of Mr. Phillips, who sends the following note:

Editor Scientific American:

On page 331, May issue of your magazine, Mr. Miyake has done some fine work in reducing a verse from Gray's "Elegy," but he made a mistake on the last line. "Sweetness" does not travel on the air. "Fragrance" is the original word.

J. N. Phillips.



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We are now in our own new Scientific American Building at 24-26 West 40th Street, New York. Come and look us over; the latch string is out.

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Last month, by way of celebrating our entry into our new home, we made a limited subscription offer—a year's subscription for only $3, instead of the usual price of $4. So many off-and-on readers took advantage of it to become regular subscribers, that we are going to extend it another month.

Until August 31, you may get a year's subscription for $3. Clip off and mail the coupon now. It means a twenty-five per cent saving. Better yet, it means getting the Scientific American regularly every month without missing a single one of the many features you will find so interesting and so much worth while.

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Science and Money

Investment Trusts

By Henry C. Trundle

KNOWN for many years to British and Scottish investors as a premier investment, the securities of investment trusts are just beginning to gain recognition in this country where their organization dates only from post-war days. The original trusts were formed in Europe to take advantage of the opportunities for higher return from enterprises in North and South America in the early days of nation building. Oddly enough, situations are now so reversed that trusts are being organized here to profit from the investment bargains obtainable in European markets. Both then and now these trusts have been important factors in the economic maintenance of countries and have proven highly satisfactory for investment purposes as well. Some of the larger European investment trusts own as many as four and five hundred individual securities and our own trusts are also approaching this size and distribution. As the securities held are of companies operating in all parts of the world and engaged in multiple lines of business it is to be readily seen that an investment trust is but an agency by which funds can be invested with wide diversification and with excellent probabilities of high yield. A trust virtually places the small investor, from the standpoint of safety, on the same footing as the wealthy investor who is enabled to distribute his funds over a wide area, for he shares in the whole accomplishment rather than risks his all on one or two ventures. Besides the ability to do more through the concentration of money, there are psychological and other reasons why the average individual would fare better through an investment trust than alone.

Organized for the purpose of investing for income, investment trusts ordinarily secure their capital through the issuance of stock, common and preferred. When conditions seem advisable, additional capital is obtained for short periods by the sale of bonds or from bank loans, with the effect that the earnings per dollar of contributed capital are materially increased. A properly managed trust also will have its capital added to through the retention of a part of the profits in a surplus or reserve fund. Because of their large purchasing capacity, trusts frequently occupy a position in new offerings equivalent to that of the underwriters. This enables them to acquire securities several points under the quoted offering price and permits of an increased profit when and as these securities can be resold to the public. As many offerings are bid up quickly and remain at their new higher prices, this source of profit is an appreciable one.

One of the chief reasons why the small investor suffers so many losses due to acts of omission or commission is that he becomes wedded to his securities and nothing can lead him to make a switch. This is not true of the management of an investment trust which relies on trained staffs of analytical experts for advice. Accordingly, when it is deemed advisable, all long term securities are replaced by short term securities, or exchanges are made among individual issues. Whether it be because of statistics or fashion, everything is done to assure the greatest profit.

"Inside Information"

As the Board of Management of a large trust is likely to contain men who are high executives in corporations, the trust can have the benefit of inside information of coming events. Sales or purchases can thus be undertaken with full confidence and at the very time when such transactions would appear as ill advised to the unknowing public. Right here it might be well to interpolate that investment trusts have frequently taken up the cudgels in behalf of the minority holders in instances of reorganizations or malpractices. Furthermore, since the directors are experts in matters of investment, securities are more apt to be purchased at low points and sold at high points. It is unfortunate, but then it almost always happens so, that the public is in a buying mood only when securities have had a sizable advance and that it becomes frightened on declines and sells at the low points, just when it should be buying. The scientific management of a trust will obviate this situation for it is not disturbed by gossip and its dealings are based on real knowledge. In fact the trusts always have orders in to buy a large number of securities at prices below intrinsic values and to sell at prices above such values. The natural swings of the market make it possible to have many orders executed each day. The trust therefore profits where the ordinary investor would in all likelihood be getting caught on the wrong side of the swings.

Trusts Always Alert

The international character of the larger trusts brings them into contact with all of the major security markets of the world, and affords them opportunities to profit by temporary depressions as they occur from time to time. For instance, in the bear raids in March, the European trusts undoubtedly picked up many shares of stock which in the mêlée were driven far below their actual values. During the subsequent recovery these shares were probably resold at a nice profit. When market conditions are stable here, some break might occur in London or Buenos Aires, affording our own trusts a similar privilege of acquiring stock at bargain prices. Curiously enough, too, the identical securities will sell at different prices at the same time on the various exchanges. As an example, we mention that the German Government bonds were selling in London at above 100 when they were quoted in New York at around 96. There was such a difference of several points for a number of other securities which had been offered simultaneously in Europe and America. This situation enables a trust to purchase at the cheaper price in one market and to sell at the higher in the other. Transactions in these securities can be carried on without any appreciable risk until such time as the prices shall have become equalized. The chances are that an individual would either not know of this situation, or knowing it, would not have the necessary capital or contacts to profit thereby.

As yet, mention has only been made of the large number and diversified character of the securities in the investment trust strong box. Since these trusts are regarded as scientifically managed, many persons are particularly interested in knowing just what are the actual holdings. Such a list can not be published because of the influence this information would have upon the security market, especially as the trusts own ability to buy and sell freely would be cramped. However, the trusts frequently make known the types of securities they are interested in and the geographical location of the companies. Of course, where a trust is formed specifically to hold railroad, public utility, bank or some other distinct class of security, the management is likely to be more liberal as to the details.

Persons who incline toward bonds over stocks, or vice versa, will be interested to know just what the practice is with respect to holdings in senior and junior securities. Earlier in the year one of our own trusts

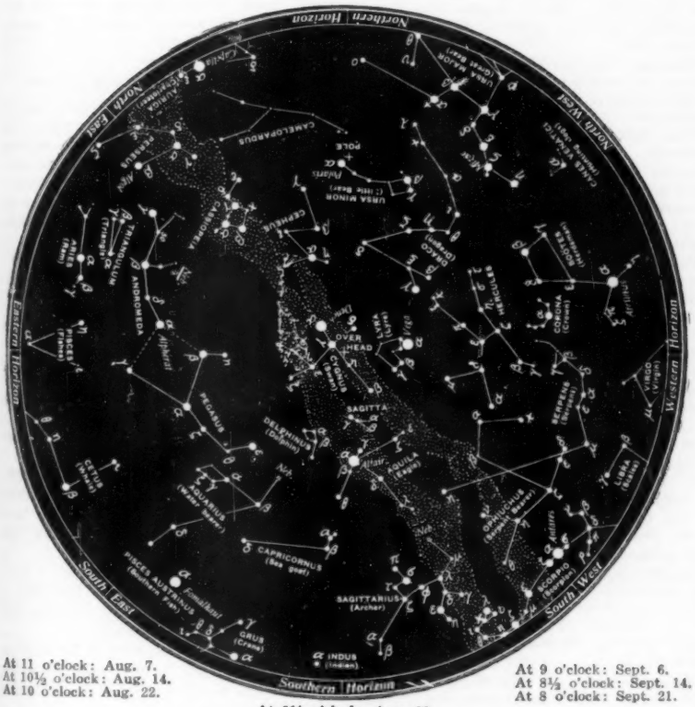
made known that of its funds 74 percent were in bonds, 22 percent in preferred stocks and bank shares and 4 percent in common stocks. The British trusts tend more toward common shares, some trusts having as much as 40 percent of their capital in them. It is not unlikely that American trusts will extend themselves in this direction as profits become smaller from domestic and foreign senior securities.

The American investor interested in investment trust securities will probably only want those of our own trusts which are purchasable for the most part not on the exchanges but "over the counter" from banking concerns. Trading in these securities is fairly active and close markets are maintained so that liquidation of holdings can be accomplished satisfactorily at any time. A choice is offered of two main types: (1) the stocks or bonds of a trust or (2) the participating certificates or beneficiary shares in a fund. From a market standpoint the first type is the most desirable, and is the type to which we have referred.

Granted that diversification and good management will assure a safe investment, it will be well to inquire into the liberalness of dividend and interest payments. Naturally the bonds of a trust will carry a fixed rate of interest and will sell at prices in direct relation to the cost of money just as does any corporation or government bond. The preferred stock will also vary but little in price and will sell on practically an investment basis. The common shares, however, are the ones to which to look for large returns and shifting prices. Efficiency of management and rapid turnover of money will be reflected in the balances left for distribution to the common. The long record of large dividend payments made to the common share holders in British and Scottish investment trusts shows that they are quite liberal. Certainly rates of around 10 percent can be considered as a satisfactory disbursement.

The Heavens in August

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.

At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

At 9½ o'clock: Aug. 29.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

The Heavens

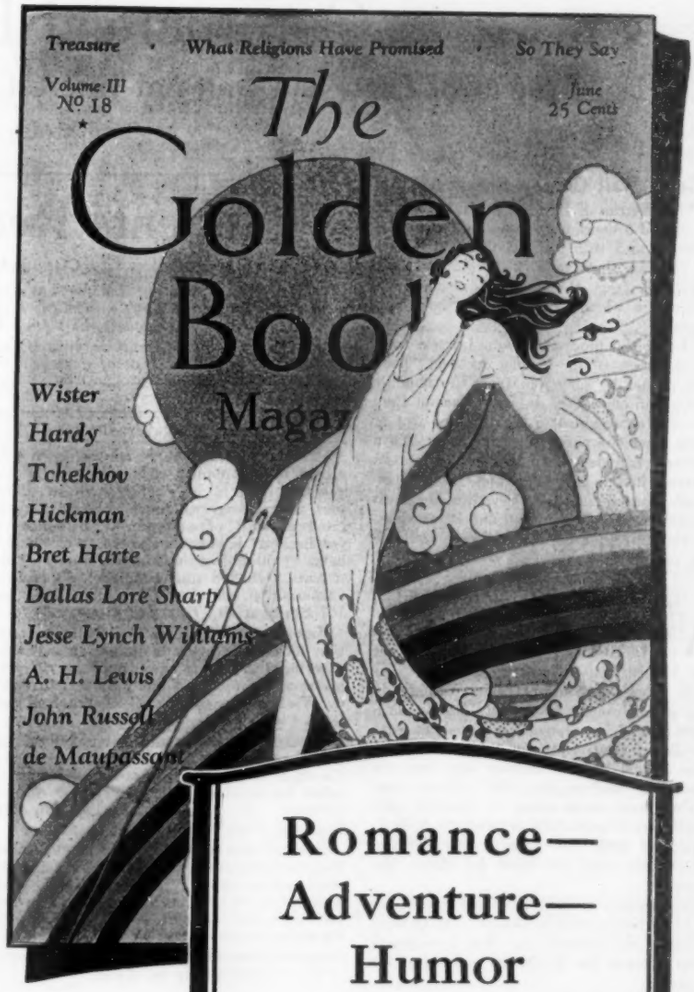
ON our map of the heavens this month we find Cygnus right overhead—the foot of the cross being to the southwest. Lyra is west of the zenith and Aquila south. Scorpio and Sagittarius are low in the southwest and Bootes in the west, with Hercules and Ophiuchus above. Draco and Ursa Major are in the northwest and Cepheus and Cassiopeia high in the north, while Perseus and Andromeda are in the northeast. Pegasus is in the east, and Capricornus, Aquarius and Pisces Austrinus in the southeast.

The Planets

Of the planets, Mercury is in conjunction with the sun on the 7th and is not visible until the latter part of the month—best about the 25th, when he is in elongation 18° from the sun, and rising at 4 A.M. so that he can just be seen in the dawn. Venus is a morning star too and rises a little after 3 A.M. Mars is growing brighter as he approaches opposition, and by this time he exceeds all the other stars except Sirius. He is in Aries, and rises at 11 P.M. at the beginning of the month, and 9:30 at its close.

Jupiter is in opposition on the 15th, and is splendidly visible all night long—the chief ornament of the evening sky. Saturn is in quadrature east of the sun on the 13th and is well visible as an evening star. Uranus is in Pisces and crosses the meridian at 2 A.M. in the middle of the month, while Neptune is in Leo and, being in conjunction with the sun on the 18th, is invisible.

The moon is new at 9 A.M. on the 8th, in her first quarter at midnight on the 16th, full at 8 A.M. on the 23rd and in her last quarter just before midnight on the 29th. She is nearest the earth on the 23rd, within a few hours of full—look out for low and high tides!—and is farthest away on the 10th. During the month she is in conjunction with Venus on the 5th, Mercury on the 8th, Neptune on the 9th, Saturn on the 16th, Jupiter on the 22nd, Uranus on the 25th, and Mars on the 28th.



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Conducted by Milton Wright

Good Will Cannot Stand Alone

THE Bureau of Internal Revenue recently issued a decision to make its regulations conform to a ruling of the Court of Claims in holding that good will could not be separated from the tangible assets of a concern in which an interest had been purchased.

"Upon the purchase of an interest in a going business," the Bureau declared, "good will cannot be separated from the tangible assets and considered as a gift exempt from tax under Section 4 of the Revenue Act of 1916, since the purchase of an interest in a business includes as an incident thereto an interest in the good will, and the gain derived from a sale of the entire business includes a sale of good will and is measured by the difference between the cost and selling price."

The Army "Tin Hat" Case

ALTHOUGH a British subject may not sue the British Government, he may sue the United States Government.

So ruled the Court of Claims recently in the action brought by John L. Brodie, Englishman and inventor of a steel helmet worn by British and American soldiers in 1918. The Brodie type of helmet was worn by American soldiers in 1918. Many complaints were made about it, however, and finally the General Staff ordered the A. E. F. equipped with the Liberty Bell helmet, which had been developed by Major McNary.

On January 1, 1918, a United States patent had been issued to Brodie. On October 3, 1919, he presented the War Department with a claim for $2,000,000 and asked for a check.

"It is conceded in argument," Judge Downey says in writing the opinion of the court, "that United States citizens have the same standing in British courts as do British subjects, but contended that neither could or can prosecute an action for tortious infringement against the Crown. . . . The true test is not whether a citizen of the United States may prosecute an action of a particular nature in a British court, but whether the doors of British courts are open to American citizens for the prosecution of 'claims' against the Crown, but necessarily only such claims as might be prosecuted by British subjects, for there, as here, there are classes of action as to which the Sovereign has not consented to be sued. We think the plaintiff has standing in this court."

The court rules, however, that in the light of the prior art there was no patentable novelty or invention in Brodie's helmet, and that the patent which had been granted to him, therefore, was invalid. His petition was dismissed.

"Direct" Through the Middleman

THE Federal Trade Commission a short time ago looked into the "Factory-To-You Furniture Store" in Philadelphia, operated by M. Goldberg, and found that the public has been laboring under the impression that the proprietor owned and operated a factory and gave his customers the benefit of profits which otherwise would go to the wholesaler, jobber and retailer.

They found, too, that the furniture was called "walnut," "genuine walnut," "combination walnut," "mahogany" and "combination mahogany." The names, however, constituted almost the only place they could find walnut and mahogany. Wherefore, they issued the necessary orders to discontinue false and misleading advertising.

The moral of which is, do not believe all you read in the store window.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

SEMIRIGID DIRIGIBLE.—Advanced lifting means of aeroplanes, combined with lifting gases, helium in lower, hydrogen in upper part of gas bag, wherein pressure is regulated at will of operator. No ballonets, valving, or ballast necessary, nor outside help, by alighting on land or water. Two patents, 1493298 and 1522761. 63 claims. Canadian patent 247713. John Twardus, 167 Seymour St., Hartford, Conn.

AEROPLANE.—Having a special construction of surfaces controllable at will for effecting the lifting power and varying the positions of the machine. Patent 1579386. C. W. Newson, 638 W. 3, North St., Salt Lake City, Utah.

AIRSHIP.—Wherein the motors for driving the propellers are so mounted and controllable that they may be drawn adjacent the cabin for repairs or other purposes. Patent 1580004. A. Bradford, 1181 Kerby St., Portland, Oregon.

SAFETY ATTACHMENT FOR AIRPLANES.—For the purpose of materially increasing the displacement and retarding descent, thus preventing serious danger to the plane and its occupants. Patent 1583745. V. J. M. Procopio, 96 Grove St., New York, N. Y.

Pertaining to Apparel

CORSET.—Which may be adjusted to the height and figure of the wearer without detaching any of the parts. Patent 1581962. J. J. Kispert, c/o I. Newman & Sons, 17 Oak St., New Haven, Conn.

WASHABLE GARTER.—Which is adjustable and will remain substantially unaffected by the washing process, as distinguished from garters having elastic portions. Patent 1581424. E. C. Blomeyer, 845 W. 62d St., Kansas City, Mo.

COMBINED SANITARY SHIELD AND RECEPTOR.—A bifurcated garment for women, adapted to encircle the hips and upper leg portions of the body. Patent 1580464. Frances H. Blumenfeld, 2011 Macdonald Ave., Richmond, Cal.

HAT.—Having greater flexibility in the portion fitting about the head whereby it will shape itself to the head and prevent binding. Patent 1582812. S. Avin, c/o F. P. Heid & Co., 11 W. 19th St., New York, N. Y.

GARMENT.—A sleeping garment, by the use of which certain parts of the body of the wearer can be kept cooled. Patent 1582385. H. C. Dauphinais, 2020 Front St., Fargo, N. D.

Chemical Processes

PROCESS OF MAKING COMPRESSED YEAST.—From molasses or other sacchariferous products, by means of which the bacteria originally contained in the mashing materials are preserved. Patent 1580500. R. Kusserow, 686 Jean St., Oakland, Cal.

PROCESS FOR PREPARING VACCINES.—Which comprises treating capsulated bacteria and bacterial toxic proteins with alkali to break the capsules and then digesting with trypsin. Patent 1584583. F. M. Wood, 2726 W. 54th St., Los Angeles, Calif.

Electrical Devices

POLE FOR CARRYING ELECTRIC CABLES, TELEGRAPH AND TELEPHONE WIRES, AND OTHER PURPOSES.—Consisting essentially of two flanged beams of rolled steel spaced somewhat apart and held together by means of tie bolts. Patent 1579965. J. C. Stobie, c/o Collison & Co., 483 Collins St., Melbourne, Australia.

ELECTRICAL SIGNALING DEVICE.—Whereby the condition of an electrical circuit may be indicated at a remote point. Patent 1580313. M. W. McIntire, 5 Dock St., Wilmington, N. C.

BRAKE-OPERATING MECHANISM FOR ELECTRIC HOISTS AND THE LIKE.—More particularly a device for the purpose of regulating the speed at which the brakes are applied. Patent 1579549. H. H. Logan, c/o Duro Metal Products Co., 2649 N. Kildare Ave., Chicago, Ill.

ELECTRIC CONTACT-BREAKER.—Of the flat-spring type, which is so damped as to enable it successfully to operate at high speed. Patent 1581186. A. J. H. Elverson, "The Lynch," Clifton Rd., Wimbledon, London, S. W., England.

RADIO INDUCTANCE COIL.—Whereby the wires may be wound in a compact cylinder without any necessity for using insulated wire. Patent 1581967. O. G. Lissen, 151 Highland Ave., Jersey City, N. J.

ELECTRICAL CONNECTER.—Whereby a circuit wire may be simply but very securely fastened within the connecter and will stand great strains. Patent 1583697. A. E. Latham, 52 Lincoln Place, Brooklyn, N. Y.

CORD HOLDER AND GUIDE.—For electric flat irons, and means whereby a slack loop may be maintained permitting freedom of movement for the iron. Patent 1584590. J. D. Archard, 5605 Grand Central Terminal, New York, N. Y.

TRAIN-OPERATED ELECTRIC SWITCH.—The operating mechanism being adapted to be actuated by the flange of a car wheel on the track rail. Patent 1585178. J. K. West, Detroit, Minnesota.

ELECTRIC SIGN.—Having a thoroughly automatic mechanism for handling an endless perforated tape, and controlling the supply of current of the illuminating lamps. Patent 1586436. F. Z. Barrundia, c/o H. Triest & Co., 35 So. William St., New York, N. Y.

PROCESS FOR THE INSULATION OF ACCUMULATOR PLATES OF DIFFERENT POLARITIES.—Consisting in applying thin sheets of wood to the sides of the plate, and a frame of ebonite to the edges in overlapping engagement. Patent 1586406. L. Caillard, c/o Office Picard, 97 Rue St. Lazare, Paris, France.

SIGN.—Which is illuminated at both sides by a single or series of electric bulbs located in openings in the sign. Patent 1586,464. R. M. Pearson and W. Letzig, 310 Spring St., Little Rock, Ark.

Of Interest to Farmers

AUTOMATIC RELEASE COUPLING.—For use in agricultural pursuits, between a tractor and a plow, automatically releasing the plow on abnormal resistance. Patent 1581467. W. A. Mueller, 810 No. Penn St., Aberdeen, S. D.

HARVESTING MACHINE.—For harvesting maize or corn, its main object being to remove the cobs or ears from the stalks while in growing position. Patent 1583751. P. T. Woodland, "Orrisdale" Florida Road, Durban, Natal, South Africa.

WATERPROOFING COMPOSITION FOR GLOVES.—Which when applied to the hands or fabric gloves will protect them from injury during the husking or harvesting of corn. Patent 1583493. F. M. Reed and C. Paulsen, c/o C. P. Anderbery, Minden, Neb.

"Stainless Steel" Name Is Public

ANY cutlery manufacturer may stamp his rust and stain resisting articles "Stainless Steel," according to a decision recently handed down by the Patent Commissioner. This decision represents a victory of several manufacturers of steel products over the American Stainless Steel Company, which heretofore has claimed a monopoly in the use of the term.

The case arose when the American Stainless Steel Company applied for registration of "Stainless Steel" as a trademark. A number of companies protested. Among these was the Camillus Cutlery Company. In the testimony it developed that the American Stainless Steel Company neither makes nor sells steel articles of any kind, but merely holds patent rights which it leases to various manufacturers.

The Patent Commissioner based his decision on the fact that the term "Stainless Steel" is one of long standing and wide use as well as on the fact that the term is purely descriptive.

New Chinese Copyright Law

THE Republic of China recently adopted a new copyright law. Apparently the law has escaped the attention of the various foreign powers in China and was not submitted to them for any criticism or approval as they yet have little or no knowledge of the new law. No specific restriction against foreigners appears in it.

Following are some of the provisions:

"An author is entitled to copyright privileges during his lifetime. In case of death such copyright passes to his heirs for a term of thirty years.

"The legal heirs of a deceased author shall be entitled to copyright for a term of thirty years on the publication of the posthumous work of the author.

"Copyright of photographs shall be granted for a term of ten years.

"If within the term of copyright, revision, alteration of the text or insertion of illustrations is made, specimens must be presented at the office where the work was originally registered.

"Anyone who pirates or plagiarizes a copyright work is liable to a fine of from $50 to $500. In addition damages may be collected by the person injured.

"Making a false statement in an application for a copyright is punishable by a fine of from $20 to $200 in addition to having his copyright cancelled.

"Where authors have been fined according to this law their literary works shall be confiscated."

Translating Trademarks

WHEN Charles E. Culpepper, of New York, recently sought to register the word "Como" as a trademark for non-alcoholic beverages the Howdy Company, beverage manufacturers of St. Louis, objected, urging that "Como" was an infringement of their trade mark, "Howdy." The resemblance was not at all clear until the opposer explained that como is the Spanish equivalent of howdy. Fortunately for Culpepper, there was another factor in the case.

"It may be deemed settled," said Acting Patent Commissioner Kinnan, "that a rival in trade cannot be permitted to translate a trademark used by another into a foreign language and obtain registration for it when used upon the same class of goods. In view of the evidence supporting the claim of the applicant of prior adoption and use, it is unnecessary to decide the question of whether the applicant has done more than translate the opposer's mark into the Spanish language.

POTATO GATHERER.—Which may be attached to any conventional form of potato digger for separating the earth from the potatoes. Patent 1581599. W. C. Roth, R. F. D. No. 35, Randall Rd., Le Roy, N. Y.

Of General Interest

IMPROVED PASTE TUBE CAP.—Adapted to collapsible paste tubes, easily operated for allowing the discharge or cut-off of the paste and possesses positive non-losable features. Patent 1570238. J. R. Gibson, 38 S. Dearborn St., Chicago, Ill.

BLOTTER ATTACHMENT FOR PEN STAFFS.—Which can be readily applied to a pen staff and will not prevent the placing of the pen in the pocket. Patent 1579465. D. Brittain, Box 248, Galesburg, Ill.

BATH BRUSH.—Applicable to any conventional tub and adjustable to any desired position, so that it will contact with a person's back. Patent 1577565. V. F. Creegan, 743 So. Beacon St., Los Angeles, Cal.

COLLAPSIBLE-TUBE CLOSURE.—Whereby a screw-threaded cap, constituting a closure, is limited in its movement and prevented from accidental loss. Patent 1580069. H. L. Moreau, c/o E. A. Derby, 123 Waverly Place, New York, N. Y.

NECKLACE CLASP.—Constructed by a single stamping so that when bent it will form a front and rear without employing solder or rivets. Patent 1579983. F. B. Wendel, c/o Hercules Novelty Mfg. Co., 126 South St., Newark, N. J.

SAFETY RAZOR.—Having three cutting edges, with means for permitting the user to keep track of the edges fresh for use. Patent 1579459. W. F. von Hammerstein, 4500 Melrose Ave., Los Angeles, Cal.

DIVING BOARD.—Designed to give a high degree of resiliency without undue strain to the portion above the fulcrum. Patent 1579510. W. S. Brown, Room 201, Men's Gym, Urbana, Ill.

CLOSURE FOR TANKS.—Which may be applied and removed from the exterior of an oil tank without necessitating the workman entering the tank. Patent 1580229. A. Boynton, 1019 City National Bank Bldg., San Antonio, Texas.

FUEL ECONOMIZER.—In the form of a preheating arrangement adapted to be employed in conjunction with furnaces. Patent 1580383. J. F. Schlappi, 2300 Pierce St., Sioux City, Iowa.

ADVERTISING DEVICE.—In the form of a fish to be floated on or below the surface of liquid, with a suitable advertisement visible. Patent 1580227. D. C. Wilhelm, Gillette, Wyoming.

PASTE-DISPENSING DEVICE.—For dispensing tooth paste, cream or the like without exposing any except that dispensed, and permitting any quantity dispensed. Patent 1581074. T. M. Macfarland, 53 Park Place, New York, N. Y.

MOLD.—Which can be associated readily with a plurality of similar elements from which the molded articles can be quickly removed. Patent 1581043. G. Ey, 307 E. 87th St., New York, N. Y.

ANIMAL TRAP.—Strong and durable, may be easily and quickly set and adjusted, and is humane in its action. Patent 1580583. W. Catlin, 308 E. Park St., Rockville, Ind.

METHOD OF MAKING TYPEWRITER RIBBONS.—Having end portions which are free from ink so that the operator can readily manipulate the same without soiling the fingers. Patent 1581040. H. B. Vannote, c/o H. M. Storms & Co., 516 Grand Ave., Brooklyn, N. Y.

TOOTHBRUSH RACK.—Including means for rigidly supporting the same from under a molding or for gripping the edge of a glass shelf. Patent 1581033. G. J. Snyder, 335 Ogden Ave., Jersey City, N. J.

METHOD OF PRESENTING AN ANIMATED PICTURE PUZZLE.—The purpose being to exercise the wits of an audience as well as to provide a feature of entertainment. Patent 1581026. I. Schwartz, c/o Schwartz Enterprises, Inc., 111 Westchester Sq., New York, N. Y.

FOUNTAIN PEN.—Held within a casing, which is automatically withdrawn or closed with the movements of the pen. Patent 1580987. J. C. Alford, Maben, Miss.

ARTIFICIAL SHINGLE.—Formed of finely ground rock asphalt and Portland cement pressed to the desired thickness, readily handled without breaking. Patent 1581308. S. B. Christy, O. M. Long and F. R. Brents, c/o Christy & Huggins Co., Louisville, Ky.

CORNER-BLOCK MOLD.—For use in making concrete corner blocks, so constructed that the deposits of concrete will not result in disalinement of the blocks. Patent 1581044. G. Ey, 307 E. 87th St., New York, N. Y.

FISH GIG.—Which may be readily disassociated from its pole without loss of the gig, and easily taken from the fish. Patent 1581321. F. E. Raithel, 1119 E. Miller St., Jefferson City, Mo.

WATCH STAND.—Whereby a watch may be supported and the face illuminated, that the hands may be visible in a dark room. Patent 1581452. E. H. Krehbiel, Donnellson, Iowa.

FRENCH DRIP PERCOLATOR.—Which does not necessitate the constant manual pouring and repouring of the water over the coffee grounds. Patent 1581871. L. S. Roberts, c/o Roberts Book Store, Hamilton, Mont.

EMERGENCY CALL DEVICE.—Attachable to the exterior of a building, a door frame or the like, and contains information for making various emergency calls. Patent 1581981. W. H. Phelps, 765 8th Ave., New York, N. Y.

WALL PROTECTOR.—For beds or other furniture contacting with the wall or baseboard of a room. Patent 1581971. F. X. Mantsion, Ashton and Willets Road, Homesburg, Philadelphia, Pa.

HANDBAG.—Of substantially usual construction, but having a secret compartment for carrying cosmetics and the like. Patent 1581985. M. Sachs, c/o Washington Leather Goods Co., 15 E. 26th St., New York, N. Y.

MEGAPHONE.—Especially adapted for use by college cheer leaders, although, of course, adapted for other uses. Patent 1581972. T. S. Mason, 66 Redding St., Hartford, Conn.

PIPE.—With hollow bowl for holding ordinary smoking tobacco, but having the form of a cigar and mouthpiece. Patent 1581989. D. Tabenau, No. 3 Rue Saint Sauveur, Seine Department, Paris, France.

EDUCATIONAL APPLIANCE.—For teaching the construction of sentences in either a native or a foreign language. Patent 1581923. J. H. Frome, Rushland, Pa.

ADAPTABLE ORNAMENT FOR DRAPERY TIE-BACKS.—The ornament on the tie-back being loosely mounted so that it may be adjusted longitudinally to suit the taste. Patent 1581909. M. Bernhard, c/o M. Bernhard & Co., 16 W. 18th St., New York, N. Y.

SAFETY GUARD FOR EARRINGS.—Which will serve to prevent the loss of the earring through the unintentional loosening of the screw clamp. Patent 1582383. K. M. Connally, 528 McCormick Bldg., Chicago, Ill.

HOLDER.—In the form of a match-holder attachment adapted for use in connection with cigarette packages. Patent 1582108. O. D. Willis and E. W. Felix, 633 14th St., Huntington, W. Va.

FASTENER AND GUIDE FOR ASPHALT SHINGLES.—Which will act as a fastening and alining means for one or a plurality of overlapped shingles. Patent 1582727. J. J. Bradfield, 56 Twombley Place, P. O. Box 86, Jamaica, N. Y.

DOLL.—With novel and positive means whereby the eyes may be made to close by pressure on a portion of the body. Patent 1582778. G. H. Parsons, c/o Averill Mfg. Co., Wales Ave. and 143d St., Bronx, N. Y.

COMBINED BATHTUB AND SHOWER CLOSET.—Which in addition to constituting a means for taking a shower or tub bath, economizes in space required. Patent 1582881. B. N. Kraemer, 426 E. 155th St., Bronx, N. Y.

Hardware and Tools

WRENCH.—Of the type termed spanner wrench, which may be readily shifted to take care of different sized objects. Patent 1579992. A. Altman, 739 Coster St., Bronx, N. Y.

BUTTING GAGE.—Which makes the chiseling of the recesses in a door, to receive butt hinges, extremely accurate and simple. Patent 1577943. C. E. Woodley, 16 South Riverside, Klamath Falls, Oregon.

LOCK FOR PLUGS.—Especially designed for use in connection with grease caps, and eliminates loss or displacement. Patent 1580016. G. S. Collins, 676 N. Maine St., Meadville, Pa.

SCREEN FASTENER AND PROTECTOR.—For holding an extensible window screen locked in applied position in a window frame. Patent 1579445. C. M. Haddox, 6 California Apt., California Ave., Charleston, W. Va.

APPARATUS FOR TEMPERING TOOLS AND THE LIKE.—Which automatically carries the tools through the tempering solutions, whereby a gradual cooling of the proper parts is accomplished. Patent 1579866. E. E. Jacobs and M. Karnes, West Frankfort, Ill.

DETACHABLE TOOTH SECTION FOR SAW BLADES.—Whereby when the teeth become dull the section may be replaced in lieu of sharpening the teeth. Patent 1581019. W. J. Roe, 217 Liberty St., Newburgh, N. Y.

CAN COVER LOCK.—Especially adapted for use on milk cans for securely holding the cover against accidental displacement, the lock being manually released. Patent 1,581,060. W. Hug, c/o Beintker & Hug Import Co., Medford, Wis.

GEAR AND WHEEL PULLER.—Constructed to remove a gear or wheel by screw means from a shaft on which it is mounted. Patent 1580982. W. I. Wooldridge, 30 Church St., New York, N. Y.

TURNING TOOL.—Designed for turning in the ends of tubular hems used in various garments for the reception of tapes. Patent 1581983. W. B. Rood, 7 Pleasant St., Ware, Mass.

SHADE AND CURTAIN BRACKET.—Which is adjustable and may be detachably secured to a window frame without the use of nails, screws or other fastenings. Patent 1581313. A. J. Gannon, 33 N. W. 2nd Ave., Miami, Fla.

HYDRANT.—Readily turned on and closed automatically without jar, may be easily taken apart for repair or replacement. Patent 1581721. P. C. Clark, 206 So. 2nd St., Montrose, Col.

SAFETY RAZOR BLADE.—Wherein means is provided to positively indicate use of the blade and prevent palming off old blades for new. Patent 1581968. J. Llobet, Bernaza 31, Piso Atto, Habana,,Cuba.

DEVICE FOR TIGHTENING FLEXIBLE LINES.—Particularly designed for use in tightening guy wires used on oil well derricks, telegraph poles or the like. Patent 1581164. A. Boynton, c/o Fontier Oil Co., City National Bank Bldg., San Antonio, Texas.

INSERTABLE JOINT.—For soil pipes and the like, wherein a new section may be inserted without disturbing the lower or upper parts of the pipe and at the same time present proper support for the superimposed sections, a substantially continuous pipe being provided. The inventor has been granted four patents, 1581755, 1581973, 1581974 and 1581975. J. J. Meyer, 334 Lenox Ave., New York, N. Y.

CASTER.—Which is ball-bearing, may be readily taken away for the purpose of replacement and quickly lubricated without detachment. Patent 1582795. C. W. Smith, Box 712, Mexia, Texas.

TWIN PACKING NUT.—Whereby a packing operation may be carried out without requiring the closing of a valve whose leaky condition necessitates its being packed. Patent 1582786. W. A. Rhodes, 711 Lexington Ave., Brooklyn, N. Y.

DRILL OR CORING TOOL.—For use in earth boring, easily operated to form a core, cut the same off and bring it out of a well. Patent 1582904. T. M. Conrey, 2001 Monroe St., Wichita Falls, Texas.

INSERTABLE SAW TOOTH AND HOLDER THEREFOR.—A holding means with resilient holding members that yield to the forcible withdrawal of the tooth by a suitable tool. Patent 1583667. A. M. Currier, 315 E. 3rd St., Aberdeen, Wash.

SWINGING-DOOR STOP.—For use in maintaining garage door or the like in open position, the device being in unobstructing position when not in use. Patent 1583650. E. H. Bobo, Box 116, 431 Bobo Ave., Ranger, Texas.

WRENCH.—Having a plurality of working heads of various sizes, easily connected to the operating means, yet readily shifted to inoperative position. Patent 1583331. V. H. Aley and A. E. McFarland, Wilson, Okla.

CLEAT FOR CONVEYER CHAINS.—Which may be easily mounted, readily renewed, and tends to lengthen the life of the chain materially. Patent 1583614. D. L. Smith, Vernonia, Oregon.

CORING TOOL.—Which collects a core or sample of formation and insures its retention while the tool is being withdrawn. Patent 1582936. F. E. Shriver, Field Supt., c/o Burmah Oil Co., Badarpur Ghat, India.

LUBRICATOR FOR FLUID-ACTUATED APPARATUS.—Such as hammers and drills, which permits of replenishing the supply of lubricant during the operation of the device. Patent 1582368. J. W. Arnold, 630 Moultrie St., San Francisco, Calif.

CUTTING TOOL.—Designed for cutting circular openings and ornamental scores in hard rubber or other material, is adjustable, and especially adapted for radio equipment. Patent 1584584. P. A. Wood, 243 Fosdick Ave., Brooklyn, N. Y.

BRACKET CONSTRUCTION.—Formed from sheet metal, adapted for use in any location, and easily assembled as a shelf or supporting bracket. Patent 1584575. O. N. Waelti, 2nd Ave., Seamans, Saskatchewan, Canada.

DOORSTOP.—Readily applicable to a door and capable of manipulation to active or inactive positions either by hand or foot. Patent 1584637. C. V. Neuviller, 52 Garfield Ave., Paterson, N. J.

Heating and Lighting

CLOSED HOT-AIR HEATING SYSTEM.—Wherein cold air is continuously taken into the same, heated and delivered in a heated condition to the rooms. Patent 1579230. T. F. Meinhardt, G. I. Ray and G. G. Ray, Box 1318, Charlotte, N. C.

PORTABLE OIL BURNER AND TORCH.—Which will act as a flare for night workers or as a snow melter for railroad switches or the like. Patent 1581078. J. Mulroy, 269 Princeton Ave., Jersey City, N. J.

WATER HEATER.—Wherein the heating coil is positioned with its ends embedded in a surrounding casing so as to eliminate leaking by expansion and contraction. Patent 1581920. C. Dargent, 360 Crescent St., Brooklyn, N. Y.

HOT AIR FURNACE.—Particularly well adapted for use with crude oil burners and the like, and which uniformly distributes the air to be heated. Patent 1585030. L. W. Hamilton, 275 Valentine St., Kenosha, Wis.

GUARD.—And protecting means, for association with heat conduits, which will be insulated from direct contact, yet will permit radiation of the heat. Patent 1586422. A. W. Furnivall, 127 Remsen St., Brooklyn, N. Y.

BURNER.—In which a combustible mixture of water and oil, providing an intense flame, may be projected a short or long distance. Patent 1586054. C. W. Turner, New York, N. Y.

Machines and Mechanical Devices

MACHINE FOR TRUING ENGINE CRANK-PINS OR SHAFT-END BEARINGS.—A relatively small, hand-operated machine readily attached to the end of the crank-pin to be trued. Patent 1579246. M. Redmond, 7312 Detroit Ave., Cleveland, Ohio.

GATE.—Having mechanism adapted to be operated by a vehicle approaching to effect the automatic opening of the gate. Patent 1578795. J. H. Bard, 160 So. Heliotrope Ave., Bell, Cal.

MINING MACHINE.—For facilitating various cutting operations, such as drift mining, open cut excavating, loading, road building, etc. Patent 1579704. H. L. Grow, 302½ Sangranado Rd., Los Angeles, Cal.

APPARATUS FOR PRODUCING STEREOSCOPIC MOVING PICTURES.—With the result to the eye of a rounded effect, as though one were looking through a window, instead of upon a screen. Patent 1579974. R. W. Tully, Box 4, Sierra Madre, Cal.

WRIST-PIN.—Wherein the pin may be firmly fastened to the crank-disk, yet may be readily assembled with or taken from the disk. Patent 1579969. O. Teel, Echo, Ore.

MACHINE FOR CASTING STEREOPLATES.—In which the mold is pressed immediately against the pot, and the flow of metal regulated by a cock. Patent 1579991. C. Winkler, c/o Winkler, Fallert & Co., Bern, Switzerland.

FILM-HANDLING MECHANISM FOR MOTION PICTURE PROJECTING MACHINES.—Which obviates the necessity of forming the film with feed perforations, thereby reducing the expense of manufacture. Patent 1579953. P. Roble, c/o J. Montoya, Jr., 143 W. 82d St., New York, N. Y.

MACHINE FOR BEAD MANUFACTURE.—An automatic machine for the manufacture of glass or enamel beads from a rod of material melted in a blowpipe. Patent 1580076. J. Paisseau, 5 Rue Blondel, Courbevoie, France.

SIGNATURE STAMP FOR MULTIGRAPHING MACHINES.—In the form of a rubber signature sheet with a flexible, elastic and con-

formable backing member thereby compensating for the variance in the diameter of the rollers. The inventor has been granted two patents, 1586000 and 1580010. H. T. Buck, c/o Buck Mfg. Co., 87 Duane St., New York, N. Y.

BIAS CUTTING MACHINE.—For cutting strips spirally from a tubular fabric, so that the strips will be on a bias with respect to the weave. Patent 1581051. P. Gardner, c/o H. M. Bunker & Co., 56 Worth St., New York, N. Y.

TWISTING DEVICE.—Operable by the bobbin-winder of a sewing machine, for twisting together a plurality of strands to form a heavier cord. Patent 1581003. E. N. and F. O. DeAlcocer, Apartado 8304, Mexico D. F., Mexico.

TUBE CLEANER.—For blowing the soot from either a water tube or fire tube boiler without interrupting the use of the boiler. Patent 1581005. J. J. McAndrews, 145-16 Greenbridge St., Jamaica South, L. I., N. Y.

PISTON-RING CONSTRUCTION. — Whereby as the piston-rings and their grooves become worn they may be very readily replaced, as compared with the present practice. Patent 1581053. J. L. Gibson, Room 608, 80 Broad St., New York, N. Y.

EVAPORATOR.—For use in marine operations where salt water must be evaporated to provide fresh water for steam boilers. Patent 1580323. J. A. Paul, 936 84th St., Brooklyn, N. Y.

BLADE AND SHOE FOR ROTARY PUMPS.—Wherein the shoe is allowed to rock as the blade moves, always engaging the surface of the pump casing flatwise. Patent 1580713. W. B. Ensign, 2350 Creston Ave., Bronx, N. Y.

WATER MOTOR.—Adapted to be sustained in submerged position in such manner that it will operate when the water moves in either direction. Patent 1579723. F. L. McQuiston, 817 Garnet St., Redondo Beach, Cal.

FLUID CUT-OFF MECHANISM.—Adapted to automatically cut off the flow of gas or other fluid when an abnormal temperature is reached, as in case of fire. Patent 1580277. C. T. Bard, 28 Lincoln Ave., Norwich, Conn.

PICKER STICK FOR LOOMS.—Which may be readily replaced when desired by the release of a catch adapted to maintain the spring normally. Patent 1580345. C. W. Stossel, Front Royal, Va.

REGRINDING AND REBORING MACHINE.—Ordinarily employed in reboring, but readily converted into a device for regrinding operations. Patent 1580379. J. Locken, Comstock, Minn.

WINDMILL.—Provided with a novel form of packing member and means for maintaining the transmission shaft in a well-lubricated condition. Patent 1580388. J. F. Struble, 225 E. "B" St., Hutchinson, Kan.

STARTING DEVICE FOR PACKED FOLDED PAPER.—Particularly the first unit of folded tissue such as is commonly used in lavatories. Patent 1579429. L. J. Arms, 2180 Green St., San Francisco, Cal.

EXCAVATING MACHINERY.—Designed for digging ditches in road work or for general purposes, a greater depth and width being cut than with ordinary machines. Patent 1581318. J. O. Lium, Christine, N. D.

CONCRETE MIXER.—Wherein the discharge mechanism is readily controllable, may be shifted to an operable or inoperable position and is releasable. Patent 1581587. O. G. Mandt, c/o American Cement Machine Co., Keokuk, Iowa.

SLIDE-SHOE ATTACHMENT FOR ROAD GRADERS.—Which will tend to prevent irregular cutting movements of the scraper blades. Patent 1581414. H. T. Young, 124 Pearl St., Darlington, S. C.

CATCHALL FOR MULTIPLE EFFECT EVAPORATORS AND VACUUM PANS.—For use in sugar factories, for catching the heavy liquor carried by the vapors and returning the same back to the pans. Patent 1581220. P. Mir, c/o Wm. Gawrie, Box 2, San Pedro de Macoris, Dominican Republic.

TRUMPET FOR COTTON MACHINES.—A silver pan stop motion adapted for use with a stop motion apparatus of combing machines. Patent 1582159. A. J. Blackwood, Box 86, Carrboro, N. C.

ROLLER-BEARING PRESSING ROLLER FOR DRAWING AND SPINNING FRAMES.—Whereby to bring about improved results in the action of the pressure roller on strands of wool, worsted or cotton. Patent 1582752. J. S. Hoyle, 34 Park St., Ware, Mass.

HALF-MOON ROLL-MAKING MACHINE.—Capable of being worked by power or hand for forming the dough preparatory to baking the rolls. Patent 1582382. M. Collis, 165 King St., Charleston, S. C.

MEAT CUTTER.—A motor-driven implement for butchers' use, both for cutting the meat and sawing through bones. Patent 1582483. G. B. Runyan, Kusa, Okla.

ATTACHMENT FOR ADDRESSING MACHINES.—For use on standard addressing machines, for permitting an operator to print the name, street and city address in various ways. Patent 1582743. H. A. Forsman, Columbus Drive, Tenafly, N. J.

Medical and Surgical Devices

SYRINGE OR PUMP.—For the transfusion of blood, wherein means are provided for drawing in blood from one patient, and forcing it into another. Patent 1585628. J. A. Pfarre, 107 E. 28th St., New York, N. Y.

OBSTETRICAL FORCEPS. — Wherein the blades are arranged in the same plane as the handle with a single connection, one blade being independently pivotally mounted. Patent 1585523. L. G. Barton, c/o Geo. Tieman & Co., 107 E. 28th St., New York, N. Y.

Prime Movers and Their Accessories

ATTACHMENT FOR INTERNAL-COMBUSTION ENGINES.—Whereby gases within the crankcase of an internal-combustion engine may be drawn into the intake manifold of said engine. Patent 1580739. M. N. Lebecque, Box 332, Gilbert, Nev.

TRIPLE SEAL PISTON RING.—In which the likelihood of escapement of the compression by leakage past the ring is lessened. Patent 1581484. H. E. Deputy, Addison Hotel, Detroit, Mich.

VALVE SILENCER.—Adaptable to both tappets and cross arms for the purpose of silencing the spaced apart valve actuating parts. Patent 1583335. A. F. Borschel, 43 Welmont Place, Buffalo, N. Y.

INTERNAL COMBUSTION ENGINE.—Which eliminates the tappet valve and the cam shaft, and substitutes a rotary overhead valve, thus eliminating many parts. Patent 1582377. M. Broadbere and J. W. Costello, Box 1111, Crescent City, Calif.

REBORING APPLIANCE FOR ENGINE BEARINGS.—Of internal combustion engines, assuring perfect alignment, not only between the main bearings, but between the crank shaft and cylinders. Patent 1585026. A. T. Green, 202 3rd St., So. Aberdeen, S. D.

ROTARY INTERNAL COMBUSTION ENGINE.—Of simple construction, economically operated, having a maximum power at low speed, and absence from vibration. Patent 1583,-509. J. K. Morris, 127 So. Myrtle Ave., Monrovia, Calif.

Railways and Their Accessories

SLACK ADJUSTER.—By means of which the brake will be applied uniformly to every car in a train, thus eliminating jerks. Patent 1581438. D. Grattan, 2080 W. 12th St., Los Angeles, Cal.

CAR-STOPPING DEVICE.—For use in lieu of a bumper for stopping cars at a terminal when approaching at undue speed. Patent 1581987. H. H. Shepard, Gen'l Supt., D., L. & W. R.R., Scranton, Pa.

COUPLER.—Particularly adapted for use in the coupling of railway cars, can be swung to releasing position while under stress. Patent 1582799. J. B. Stewardson, Colby, Kan.

FORCED DRAFT APPARATUS.—Which will supply the necessary air draft to insure a full and complete combustion, for locomotives burning hard coal. Patent 1583726. P. F. Lynn, c/o F. J. Flannery, 117 Market St., Pittston, Pa.

COMBINED METALLIC TIE AND FASTENER.—The inventor has been granted five patents of a similar nature for combination concrete and metallic ties, wherein a tie with clips is so arranged that the rail may be renewed without disturbing the tie, the ties are also capable of being insulated for use in block signal systems. Patents 1586,-049, 1586050, 1586051, 1586479 and 1586,-480. J. G. Snyder, c/o Keystone Metal Tie Corp., 441 Lexington Ave., New York, N. Y.

STRUCTURAL METAL BEAM.—Capable of use for structural work for metal ties or other purposes, with certain parts so formed as to be bent to act as shoulders, the beam may be used in any length with either open or closed ends. The inventor has been granted two patents 1586052 and 1586053. J. G. Snyder, c/o Keystone Metal Tie Corp., 441 Lexington Ave., New York, N. Y.

LOCOMOTIVE-FRAME BINDER SUPPORT.—Which provides a substantial and durable securing means, with easy removal and replacement of the binders. Patent 1585597 A. H. Miller, 712 Mitchel St., Clovis, N. M.

Pertaining to Recreation

GAME APPARATUS.—For playing a game after the manner of ten pins, bowling or pool, the ball being propelled by a cue. Patent 1580036. W. A. Haegele, 717 Grove St., Elizabeth, N. J.

AMUSEMENT APPARATUS.—To be erected on fair grounds and like places for the purpose of giving persons the sensation of flying in an airship. Patent 1580460. D. S. Willeford, 1524 20th Ave., Oakland, Cal.

TOY GAS-FILLING PUMP.—Which in operation has the same appearance as the pumps used at automobile service stations. Patent 1581906. C. G. Austin, 703 Clay St., Woodstock, Ill.

TOY AIRPLANE.—Primarily designed for the amusement of children and made in such manner that it may be readily assembled. Patent 1581980. F. Parsons, Fort Omaha, Neb.

GAME APPARATUS.—Which affords facilities for playing a game which is in the similitude of the game of baseball. Patent 1582150. J. W. Weaver, 415 Cutler St., Raleigh, N. C.

GOLF BALL.—Provided with visible signal means permitting the owner, or others, to locate the ball in tall grass, for instance. Patent 1583721. P. S. Kane, Kane, Pa.

GAME.—Comprising a board representing a battle area, and tokens or pieces in the form of battleships. Patent 1584668. J. Sjogren, 152 Beaver St., Hyde Park, Mass.

PROTECTING GLOVE FOR PLAYING HANDBALL.—Including simple effective reinforcement for those parts upon which the greatest strain is thrown, thus avoiding premature breakage. Patent 1584304. B. Kennedy, c/o Ken-Wel Sporting Goods Co., Glovers-ville, N. Y.

ROLLER SKATE.—Adapted for use in playing hockey, constructed with three wheels, and a special guard between the axles for stopping the ball. Patent 1583193. F. R. Shugart, 3957 4th Ave., Sacramento, Calif.

Pertaining to Vehicles

LEAF-SPRING LUBRICATOR.—Having means for quickly and easily spreading the leaves and injecting grease into the space between. Patent 1578699. R. W. Ammons, 2516 Central Ave., Los Angeles, Cal.

TIRE.—Comprising a plurality of separate and independent inflatable sections, any one of which may be renewed without disturbing the others. Patent 1579674. A. Teresa, c/o Compania Hespena Americana de Heneguen, Nuevitas, Caw, Cuba.

AUTOMOBILE LOCK.—Which affords facilities for releasably holding an operating lever, such as the emergency brake, against movement from a given position. Patent 1581035. T. J. Stephenson, P. O. Box 642, Montrose, Cal.

PRESS FOR LEVELING MAGNET ASSEMBLIES.—For facilitating repair work on a well-known type of automobile, in which magnets are assembled in connection with the fly-wheel. Patent 1580426. R. A. Farnam, Box 908, La Grange, Oregon.

POWER TRANSMISSION. — Whereby power can be transmitted from one rotary element to another at a changed speed ratio without shifting any gears. Patent 1579433. J. H. Blair, 447 Valencia St., San Francisco, Cal.

METHOD OF DAMPING OSCILLATIONS IN LEAF-SPRINGS FOR VEHICLE SUSPENSION AND OTHER PURPOSES.—By a special form of curvature of the leaves and a special form of maintaining the straps in position. Patent 1581916. F. L. Broussouse, c/o Office Picard, 97 Rue St. Lazare, Paris, France.

CREEPER.—For the purpose of enabling a mechanic to move more readily beneath a motor vehicle. Patent 1581592. F. R. Neal, 76 Brentwood St., Woodfords, Maine.

ULLAGE CALCULATOR.—Which will allow filling station operators to accurately ascertain what amount of gasoline is necessary to fill an automobile tank. Patent 1580529. O. A. Petree, Palo Alto, Cal.

IGNITION TESTER.—Which may be so positioned that the control will be on the dashboard of an automobile, and any one cylinder may be tested. Patent 1581976. W. V. Moore, c/o Wm. V. Kulp, 49 Wall St., New York, N. Y.

RADIATOR INDICATOR.—For use on automobiles for showing the temperature condition of either the water in the radiator or the engine. Patent 1581480. A. P. Anderson and A. L. Tyrrell, 418 Helen Ave., Detroit, Mich.

WHEEL.—In which the felly has novel means for engaging with both sides of the rim to provide a larger supporting surface. Patent 1581639. S. Kaplan, Monroe, La.

SLED RUNNER FOR COASTERS.—Quickly attached or detached from a wheel, such as are used on baby carriages, gocarts and wheeled coasters. Patent 1581420. E. B. Beeler, c/o S. J. Harbaugh, 2721 S. Michigan Ave., Chicago, Ill.

WHEEL.—In which positive means is provided for preventing movement of the rim with respect to the felly. Patent 1581348. S. Kaplan, Monroe, La.

CRANK-CASE DRAINING DEVICE.—Which may be readily operated to disconnect the oil plug and receive and carry off the old used oil. Patent 1582758. H. A. Jones, 6th Ave. and Van Buren St., Phoenix, Ariz.

CAR FENDER.—Whereby in the event a person is struck by the automobile he will be tripped and caught in the fender. Patent 1582729. J. C. Buchenau and E. R. Bishop, 202 Lillian Ave. and Eastwood St., Syracuse, N. Y.

SPARE-TIRE SAFETY GUARD.—Which functions as an enclosure to protect the tire and permits of carrying articles within the space. Patent 1583659. J. P. Clarke, 1419 Boulevard, West New York, N. J.

EMERGENCY BRAKE AND SAFETY LOCK COMBINED.—Adapted to be dropped upon the ground so that the rear wheels of the vehicle will run up thereon and quickly stop. Patent 1582911. F. A. Eichorn, 208 Walnut St., Chattanooga, Tenn.

AIR-RELEASING DEVICE.—To be attached to the valve stem of a pneumatic tire for permitting the escape of the surplus pressure fluid. Patent 1582928. D. H. Hoag, Black Hoof Station, Nemadji, Minnesota.

SPARK-RETARDING MOTOR STARTER.—For Ford cars, which will do away with the foot pressure starter, and avoid the dangers of starting with the spark advanced. Patent 1583498. R. O. Simms, and H. B. Mattox, Leesburg, Fla.

BUMPER.—In the form of an air-filled cylindrical element of resilient material, for use on the extremities of the chassis. Patent 1584081. J. L. Douglass, 102 Maiden Lane, New York, N. Y.

EXHAUST STOVE FOR AUTOMOBILES.—Adapted to be connected with the exhaust manifold, to form a heating chamber for receiving a plurality of cooking vessels. Patent 1584514. G. Deeter, Burbank, Calif.

WARNING SIGNAL.—Which will resist closing of an automobile door or a filing cabinet, when a hand is in proximity of the opening. Patent 1584521. D. F. Ebbert, Main and 4th Sts., Wheeling, W. Va.

Designs

DESIGN FOR A CEILING FIXTURE.—Patent 69971. M. Schlepp, c/o Sterling Spring & Stamping Works, 476 Broome St., New York, N. Y.

DESIGN FOR AN ARTICLE OF FOOTWEAR.—Patent 69987. T. Davis, c/o Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A DECK OF CARDS.—Patent 70032. W. T. Seto, 99 Quincy St., Brooklyn, N. Y.

DESIGN FOR A COMBINATION CALENDAR AND KITCHEN MEMORANDUM CARD.—Patent 69997. L. R. Keller, 100 W. 105th St., New York, N. Y.

DESIGN FOR A WALL BRACKET.—Patent 70144. P. Siptrott, c/o Munn, Anderson & Munn, Woolworth Bldg., Broadway, New York, N. Y.

DESIGN FOR DECORATIVE TOY ANIMAL OR THE LIKE.—The inventor has been granted five patents of similar nature. 70189, 70190, 70191, 70192, 70193. A. W. Samuels, c/o Voge Merchandise Co., 91 5th Ave., New York, N. Y.

DESIGN FOR A PAPER WEIGHT OR SIMILAR ARTICLE.—Patent 70173. A. M. Holtz, 667 Ponce de Leon Ave., Atlanta, Ga.

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His return in 1832 was said to close the period of his artistic, and to open that of his scientific life. His quest to "transmit intelligence by electricity" met with many struggles and privations over a period of twelve years. He was in dire poverty, and denied himself the common necessities of life. It was not until 1836 that he had completed any apparatus that would work. His first instrument was exhibited to friends on September 2, 1837, in the University of the City of New York, where a circuit of 1,700 feet of copper wire had been set up. The results were sufficiently satisfactory to interest the Messrs. Vail of New Jersey, who thenceforth became associated with Morse. His trials in getting patents and financial support in this country, as well as England, France and Russia, are well known. He obtained a patent in France, but it was subsequently appropriated by the French Government without compensation to himself. In 1843 Congress passed the long delayed appropriation. On May 24, 1844, the first line from Baltimore to Washington was used. In 1847 Morse was compelled to defend his invention in the courts.

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